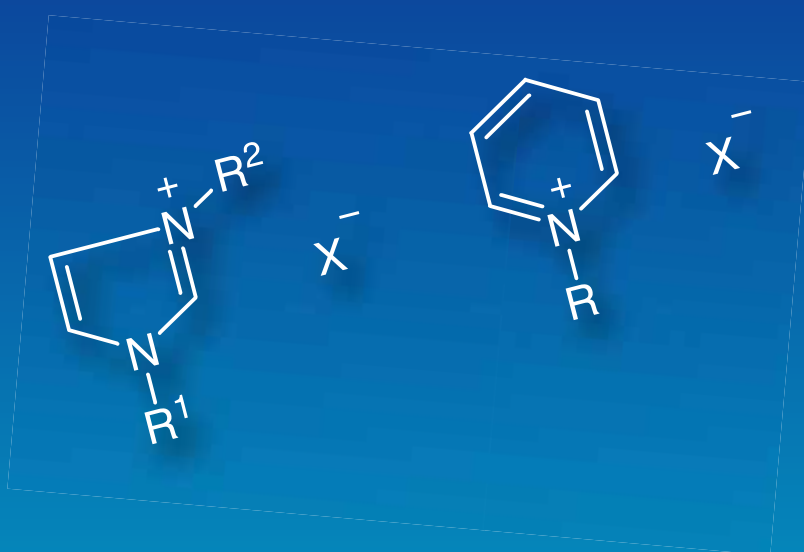


离子液体

Ionic Liquids



铵盐

咪唑鎓盐

吗啉鎓盐

磷盐

哌啶鎓盐

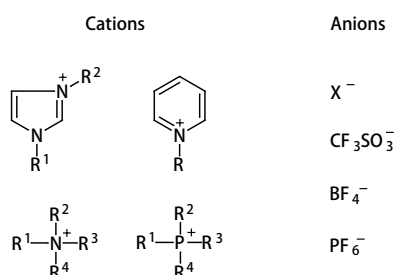
吡啶鎓盐

吡咯烷鎓盐

铈盐

离子液体

近年来，从绿色化学的角度出发，更多研发人员投入到环境友好反应的研究中。例如，空气中的氧化反应，水、超临界流体和氟溶剂中的反应。最近，离子液体作为有机合成的绿色反应溶剂引起很多关注。



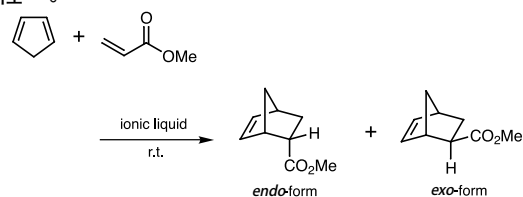
如上图所示，离子液体是盐类，由阳离子和阴离子构成，阳离子如咪唑鎓、吡啶鎓、季铵基和季磷基，阴离子如卤素离子、三氟甲磺酸根、四氟硼酸根和六氟磷酸根，在相对低温下离子液体以液体状态存在。它们的显著特征包括几乎无蒸气压、不易燃、不可燃、高热稳定性、相对低的粘度、作为液体较宽的可操作温度范围和高离子导电性。当离子液体用作反应溶剂时，溶质仅仅被离子溶解，与水或普通有机溶剂相比，反应在完全不同的条件下进行。因此，离子液体有望呈现出不同寻常的反应性，其在各种有机反应中的应用不断被发掘。

含氯铝酸根阴离子的离子液体已经被研究多年。这些离子液体不仅仅用作反应溶剂，当阴阳离子的比例改变时，它们还表现出Lewis酸或Lewis碱的性质。然而，因为对湿度的高灵敏性，它们只能在惰性气氛或真空中反应。另一方面，研究人员发现含有如六氟磷酸根阴离子的离子液体能在空气中形成稳定的盐类，从而引导了今天大量稳定的离子液体的合成。而且，一些离子液体在水和极性有机溶剂中溶解度很小。利用这个特性，离子液体可以在有机溶剂萃取产物后被回收利用，这样可以减少传统溶剂的浪费。另外，离子液体作为安全溶剂，由于其低挥发性得到很多关注。

下面是一些离子液体的应用示例。

1. Diels-Alder反应

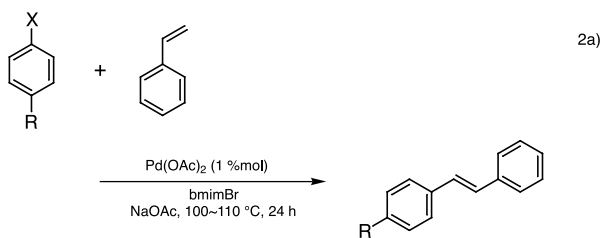
环戊二烯和丙烯酸甲酯的Diels-Alder反应已见报道。在该反应中使用1-乙基-3-甲基咪唑鎓氯化物/氯铝酸盐[emimCl/(AlCl₃)_x]，*endo*/*exo*-型产物的比例随着emimCl/(AlCl₃)_x比例的不同而变化很大。相比碱性emimCl/(AlCl₃)_x，使用酸性emimCl/(AlCl₃)_x时*endo*-型产物的数量增加了4倍^{1a)}。当利用1-丁基-3-甲基咪唑鎓四氟硼酸盐 (bmimBF₄) 进行相同反应时，它表现了与Lewis碱性emimCl/(AlCl₃)_x相似的反应性^{1b)}。



ionic liquids	composition (% AlCl ₃)	time (h)	<i>endo</i> / <i>exo</i> ratio	Y. (%)	
emimCl/(AlCl ₃) _x	48 (basic)	22	4.88	32.3	1a)
emimCl/(AlCl ₃) _x	48 (basic)	72	5.25	95	1a)
emimCl/(AlCl ₃) _x	51 (acidic)	22	19	53	1a)
emimCl/(AlCl ₃) _x	51 (acidic)	72	19	79.4	1a)
bmimBF ₄	-	72	4.3	91	1b)

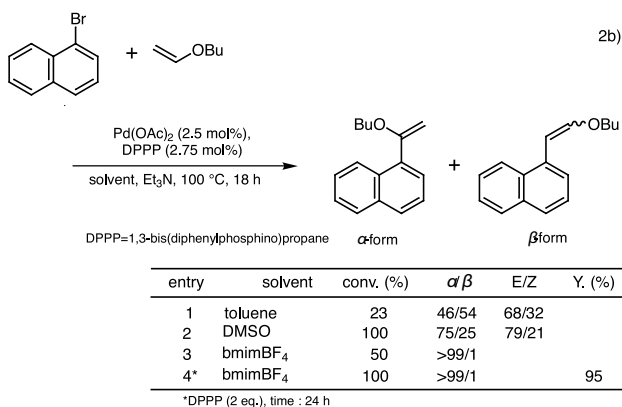
2. Heck反应

在钯催化的Heck反应中，一般使用DMF和乙腈等极性溶剂，底物通常为芳基碘化物。如果使用价格较便宜但反应性较低的芳基溴化物或氯化物，必须使用更多的活性催化剂或者添加膦配体来保持催化活性。不过，用1-丁基-3-甲基咪唑鎓溴化物 (bmimBr) 作溶剂时，芳基溴化物和苯乙烯可以在不添加膦配体的情况下，以高收率得到芪类化合物 2a)。



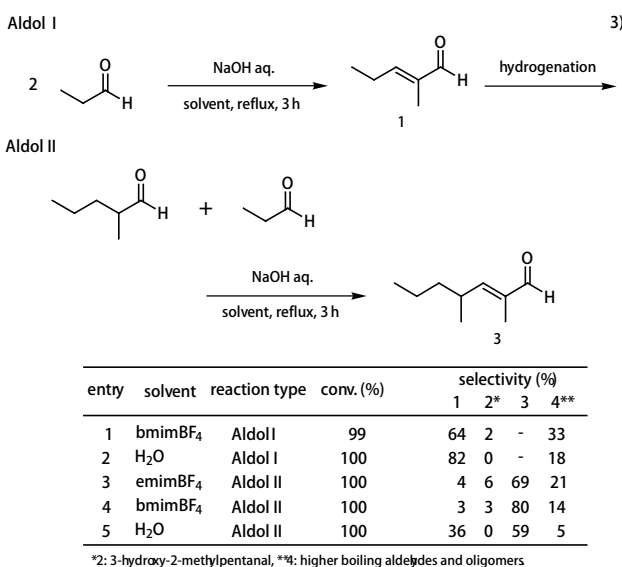
entry	X	R	conv. (%)	Y. (%)
1	I	H	100	99
2	Br	CHO	100	90
3	Br	MeCO	79	88

在常规的Heck反应条件下，具有给电子基团的烯醇醚与芳基卤化物反应，生成 α -取代和 β -取代的混合物。然而，当使用bmimBF₄作溶剂，烯醇醚和芳基卤化物反应只特定生成 α -取代物^{2b)}。另外，已经有报道使用季铵盐四丁基溴化铵 (Bu₄NBr) 的Heck反应^{2c)}。



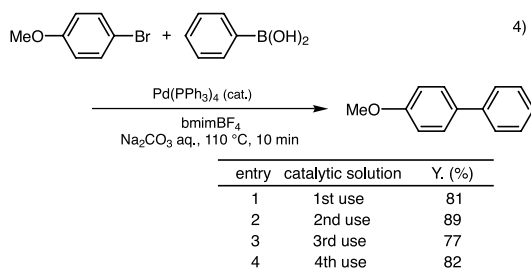
3. Aldol缩合(羟醛缩合反应)

使用离子液体的Aldol缩合(羟醛缩合反应)已见报道。以丙醛为原料,通过两次Aldol缩合反应可得2,4-二甲基庚-2-烯醛 **3**,在Aldol I反应中,使用离子液体时的转化率和水介质相当,不过产物的选择性降低了(如下表所示)。这是因为产物**1**在离子液体中溶解度高而引发了副反应。相反,在Aldol II反应中,使用离子液体时产物的选择性相较水介质却增强了。这是因为**1**的氢化产物难溶于水而易溶于离子液体³⁾。



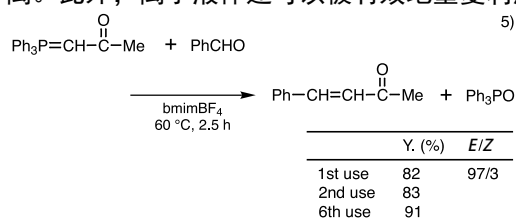
4. Suzuki-Miyaura偶联反应

Suzuki-Miyaura偶联反应中,在钯催化剂和碱的存在下,芳基卤化物和芳基硼酸反应生成了联芳基化合物,然而催化剂的去除一直是个难题。在利用离子液体作溶剂的体系中,反应完成后产物可以用醚萃取得到,而催化剂仍留在离子液体中。因此,离子液体和催化剂可以被重复利用⁴⁾。



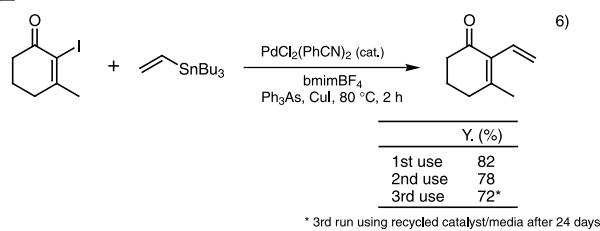
5. Wittig反应

Wittig反应是一种形成碳碳双键的有用方法。然而,产物和副产物三苯基氧化膦的分离是个经典难题。通常利用结晶或色谱法进行分离纯化。当使用离子液体作为溶剂时,反应完成后,通过醚萃取和甲苯萃取相结合,可以很容易的将产物和氧化膦分离。此外,离子液体还可以被有效地重复利用⁵⁾。



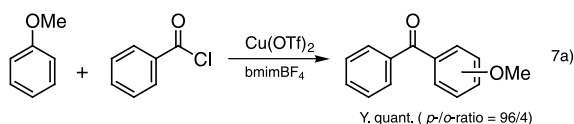
6. Stille反应

Stille反应是很有用的反应,在钯催化剂存在的条件下,有机锡化合物可以和亲电试剂反应,在温和的条件下生成C-C键。乙烯基三丁基锡和碘代环己烯酮在离子液体中反应时,产物可以用醚萃取,而催化剂则留在离子液体中。因此,离子液体和催化剂可以被重复利用。另外,该离子液体/催化剂相在空气和湿气中稳定,可以长时间储存而不损失活性⁶⁾。



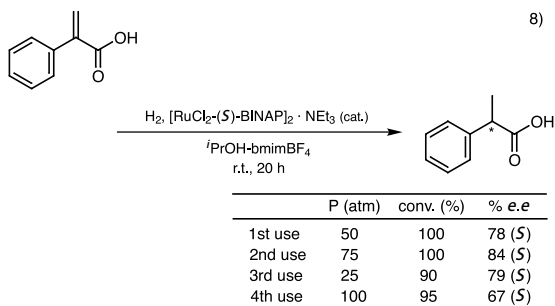
7. Friedel-Crafts反应

下面是Friedel-Crafts反应的一个示例。在bmimBF₄中,三氟甲磺酸铜催化苯甲醚的苯甲酰化反应,能在1h内定量得到相应的甲氧基二苯甲酮,其中对位-/邻位-产物的比例为96/4^{7a)}。在乙腈中进行同样的反应时,1h内转化率较低,为64%,其中对位-/邻位-产物的比例为93/7。另外,还有报道利用emimCl/(AlCl₃)_x对吡啶进行区域选择性酰化^{7b)}。



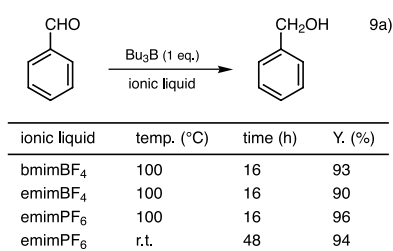
8. 加氢反应

在均相手性过渡金属络合物催化的碳碳双键不对称加氢反应中，催化剂的回收和产物的分离经常让人困扰⁸⁾。Dupont等曾经报道过一个例子，原料可以在离子液体和醇的两相体系中反应。反应完成后，产物留在醇相，而催化剂留在离子液体相中。因此，产物和催化剂可以很容易地通过倾析分离。另外，留在离子液体中的催化剂可以被重复利用而不损失活性。



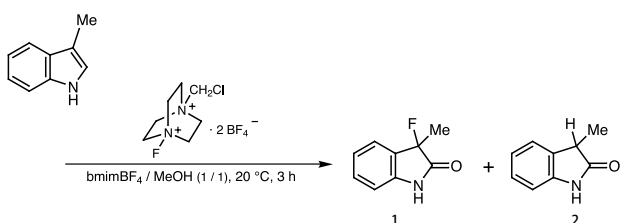
9. 还原反应

利用三烷基硼烷进行的醛还原反应是一个重要的有机转化反应。然而，使用简单的三烷基硼烷的还原反应一般需要150°C以上的反应温度。Kabalka等报道了在bmimBF₄、emimBF₄和1-乙基-3-甲基咪唑鎓六氟磷酸盐(emimPF₆)等离子液体溶剂中进行此类还原反应^{9a)}。例如，当苯甲醛在emimPF₆中被三丁基硼烷还原时，反应在100°C下即可迅速进行，并以高收率得到了产物。该反应即使在室温下也能进行，尽管相对而言需要较长的反应时间。另外，利用离子液体的光还原反应也已见报道^{9b)}。



10. 氟化反应

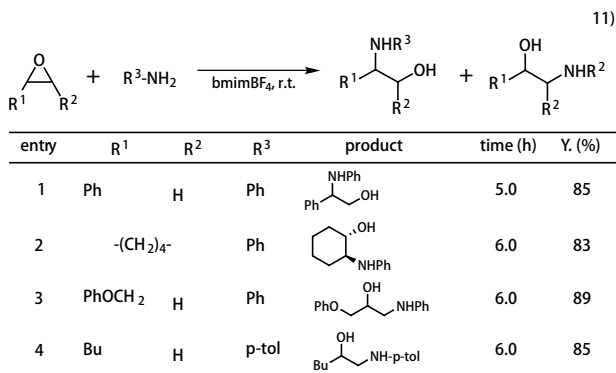
在杂环化合物中引入氟对生物活性化合物的合成很重要。利用*N*-氟-*N'*-(氯甲基)三乙二胺双(四氟硼酸盐)作氟化剂，bmimBF₄作溶剂进行咪唑的亲电氟化反应时，与传统方法(下表第1行)相比，在短时间内即可高收率地得到3-氟-2-氧代咪唑类化合物¹⁰⁾。



entry	solvent	cosolvent (1/1)	temp. (°C)	time (h)	1 (%)	2 (%)
1	MeCN	H ₂ O	r.t.	overnight	71	small amount
2	bmimBF ₄	MeOH	20	3	99	-

11. 开环反应

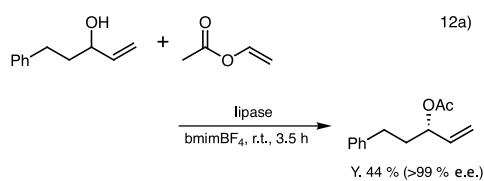
β -氨基醇是一种合成生物活性化合物的有用砌块。有一种合成 β -氨基醇的方法是利用胺使环氧化物开环。然而，这些反应需要在高温下进行，并且要使用过量的胺。高温反应条件不仅会破坏某些官能团，而且还不利于控制区域选择性。随后，多种活化剂或促进剂被开发出来，如金属酰胺化合物、金属三氟甲磺酸盐和过渡金属卤化物。然而，因为它们大部分价格昂贵或者需要化学计量的量，从而限制了它们的实用性。在利用离子液体的体系中，反应可以在室温下进行，并且可以高产率得到 β -氨基醇¹¹⁾。



以缩水甘油醚或烷基环氧乙烷为例(上表第3和第4行)，胺攻击环氧化物上空间位阻较小的位点。反应后，产物用醚萃取，接着在80°C下减压干燥。离子液体可以被重复利用五次而不损失活性。

12. 酶促反应

利用离子液体的酶促反应也已有报道¹²⁾。众所周知，脂肪酶可以在非天然的反应条件下保持活性，已被用于很多在有机溶剂中进行的反应。例如，有机溶剂中进行的酯基交换反应是一种制备光学活性化合物的很有用的合成方法。在离子液体中进行烯丙醇的不对称酯交换反应，目标产物的收率和在有机溶剂体系中相近^{12a)}。



如上所述，离子液体已被用于多种反应，对提高产率和溶剂的回收再利用的研究也已有报道。此外，它们在烷基化¹³⁾、烯丙基化¹⁴⁾、环氧化¹⁵⁾、环加成¹⁶⁾、氢化酯化¹⁷⁾，以及使用超临界CO₂的反应¹⁸⁾中也有效。

13. 其它应用

离子液体仅由离子构成，而且具有高离子导电性，因此在电化学应用中也引发了关注。例如，它们作为蓄电池电解质得到广泛研究。这些电解质需要具有如下特性：高离子导电性，不挥发性，热稳定性，不燃性以及无腐蚀性，离子液体正好满足这些要求。此外，也有研究人员对1-烷基-3-甲基咪唑鎓碘化物作为一种燃料敏化太阳能电池的电解质进行了试验¹⁹⁾。

最近，Hamaguchi等在报道中指出1-丁基-3-甲基-咪唑鎓四氯高铁酸盐是具有磁性的离子液体²⁰⁾。传统的磁性液体在挥发性和相分离上是个难题。这种新的磁性离子液体正好克服了这些问题，有望用在多种领域，包括用作电机轴的封闭剂。

参考文献

- 1) a) C. W. Lee, *Tetrahedron Lett.* **1999**, 40, 2461; b) T. Fischer, A. Sethi, T. Welton, J. Woolf, *Tetrahedron Lett.* **1999**, 40, 793.
- 2) a) L. Xu, W. Chen, J. Xiao, *Organometallics* **2000**, 19, 1123; b) L. Xu, W. Chen, J. Ross, J. Xiao, *Org. Lett.* **2001**, 3, 295; c) V. P. W. Böhm, W.

- A. Herrmann, *Chem. Eur. J.* **2000**, 6, 1017.
- 3) C. P. Mehnert, N. C. Dispenziere, R. A. Cook, *Chem. Commun.* **2002**, 1610.
- 4) C. J. Mathews, P. J. Smith, T. Welton, *Chem. Commun.* **2000**, 1249.
- 5) V. L. Boulaire, R. Grée, *Chem. Commun.* **2000**, 2195.
- 6) S. T. Handy, X. Zhang, *Org. Lett.* **2001**, 3, 233.
- 7) a) J. Ross, J. Xiao, *Green Chem.* **2002**, 4, 129; b) K.-S. Yeung, M. E. Farkas, Z. Qiu, Z. Yang, *Tetrahedron Lett.* **2002**, 43, 5793; c) A. Stark, B. L. MacLean, R. D. Singer, *J. Chem. Soc., Dalton Trans.* **1999**, 63; d) C. J. Adams, M. J. Earle, G. Roberts, K. R. Seddon, *Chem. Commun.* **1998**, 2097.
- 8) A. L. Monteiro, F. K. Zinn, R. F. de Souza, J. Dupont, *Tetrahedron: Asymmetry* **1997**, 8, 177.
- 9) G. W. Kabalka, R. R. Malladi, *Chem. Commun.* **2000**, 2191; b) J. L. Reynolds, K. R. Erdner, P. B. Jones, *Org. Lett.* **2002**, 4, 917.
- 10) a) Y. Takeuchi, T. Tarui, N. Shibata, *Org. Lett.* **2000**, 2, 639; b) J. Baudoux, A.-F. Salit, D. Cahard, J.-C. Plaquevent, *Tetrahedron Lett.* **2002**, 43, 6573.
- 11) J. S. Yadav, B. V. S. Reddy, A. K. Basak, A. V. Narsaiah, *Tetrahedron Lett.* **2003**, 44, 1047.
- 12) a) T. Itoh, E. Akasaki, K. Kudo, S. Shirakami, *Chem. Lett.* **2001**, 262; b) R. M. Lau, F. van Rantwijk, K. R. Seddon, R. A. Sheldon, *Org. Lett.* **2000**, 2, 4189; c) S. Park, R. J. Kazlauskas, *J. Org. Chem.* **2001**, 66, 8395; d) T. Itoh, S.-h. Han, Y. Matsushita, S. Hayase, *Green Chem.* **2004**, 6, 437; e) T. Ito, *Yuki Gosei Kagaku Kyokaiishi (J. Synth. Org. Chem. Jpn.)* **2009**, 67, 143.
- 13) M. Badri, J.-J. Brunet, *Tetrahedron Lett.* **1992**, 33, 4435.
- 14) C. M. Gordon, A. McCluskey, *Chem. Commun.* **1999**, 1431.
- 15) G. S. Owens, M. M. Abu-Omar, *Chem. Commun.* **2000**, 1165.
- 16) a) J. Peng, Y. Deng, *New J. Chem.* **2001**, 25, 639; b) J. F. Dubreuil, J. P. Bazureau, *Tetrahedron Lett.* **2000**, 41, 7351.
- 17) a) K. Qiao, Y. Deng, *New J. Chem.* **2002**, 26, 667; b) D. Zim, R. F. de Souza, J. Dupont, A. L. Monteiro, *Tetrahedron Lett.* **1998**, 39, 7071.
- 18) S. V. Dzyuba, R. A. Bartsch, *Angew. Chem. Int. Ed.* **2003**, 42, 148.
- 19) a) P. Bonhote, A.-P. Dias, N. Papageorgiou, K. Kalyanasundaram, M. Gratzel, *Inorg. Chem.* **1996**, 35, 1168.
- 20) a) S. Hayashi, H. Hamaguchi, *Chem. Lett.* **2004**, 33, 1590; b) H. Hamaguchi, *Expected Materials for the Future (Mirai Zairyo)* **2005**, 5, 29.

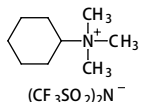
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- 21) a) T. Welton, *Chem. Rev.* **1999**, 99, 2071; b) J. D. Holbrey, K. R. Seddon, *Clean Prod. Proc.* **1999**, 1, 223; c) P. Wasserscheid, W. Keim, *Angew. Chem. Int. Ed.* **2000**, 39, 3772; d) R. Sheldon, *Chem. Commun.* **2001**, 2399; e) D. Zhao, M. Wu, Y. Kou, E. Min, *Catal. Today* **2002**, 74, 157.

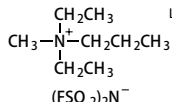
铵盐

Ammonium Salts

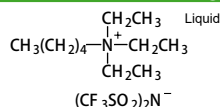
C1966 5g

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imide
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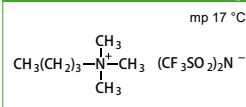
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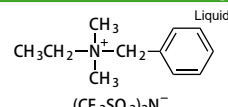
A2274 5g

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imide
CAS RN: 906478-91-9

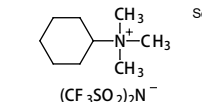
B3233 5g

Butyltrimethylammonium
Bis(trifluoromethanesulfonyl)-
imide
CAS RN: 258273-75-5

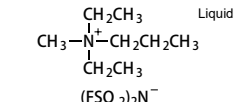
B5427 5g

Benzyl(ethyl)dimethylammonium
Bis(trifluoromethanesulfonyl)-
imide
CAS RN: 1186103-43-4

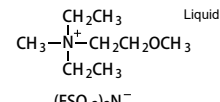
E1282 5g

Ethyl(3-methoxypropyl)dimethyl-
ammonium Bis(trifluoromethane-
sulfonyl)imide
CAS RN: 1373334-05-4

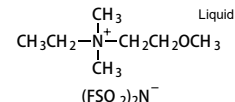
E1283 1g 5g

Ethyl(dimethyl)(2-phenylethyl)-
ammonium Bis(trifluoromethane-
sulfonyl)imide
CAS RN: 1804970-28-2

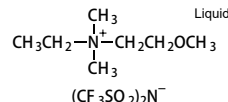
D5238 1g

Diethyl(2-methoxyethyl)-
methylammonium
Bis(fluorosulfonyl)imide
CAS RN: 1079129-48-8

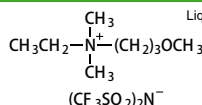
E1275 1g

Ethyl(2-methoxyethyl)-
dimethylammonium
Bis(fluorosulfonyl)imide
CAS RN: 1235234-35-1

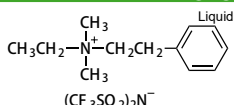
E1281 5g

Ethyl(2-methoxyethyl)dimethyl-
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sulfonyl)imide
CAS RN: 557788-37-1

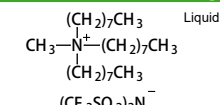
E1282 5g

Ethyl(3-methoxypropyl)dimethyl-
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sulfonyl)imide
CAS RN: 1373334-05-4

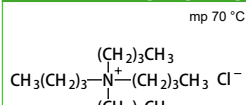
E1283 1g 5g

Ethyl(dimethyl)(2-phenylethyl)-
ammonium Bis(trifluoromethane-
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CAS RN: 1804970-28-2

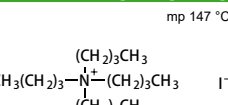
M1660 5g

Methyltri-*n*-octylammonium
Bis(trifluoromethanesulfonyl)-
imide
CAS RN: 375395-33-8

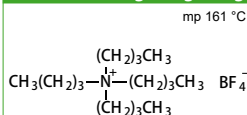
T0055 5g 25g 100g

Tetra-butylammonium
Chloride
CAS RN: 1112-67-0

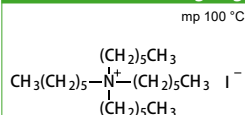
T0057 25g 100g 500g

Tetra-butylammonium
Iodide
CAS RN: 311-28-4

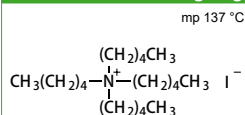
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Tetra-butylammonium
Tetrafluoroborate
CAS RN: 429-42-5

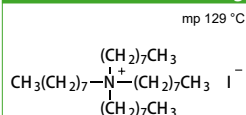
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Tetrahexylammonium
Iodide
CAS RN: 2138-24-1

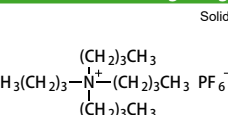
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Tetraamylammonium
Iodide
CAS RN: 2498-20-6

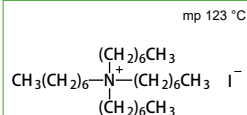
T1155 5g

Tetra-*n*-octylammonium
Iodide
CAS RN: 16829-91-7

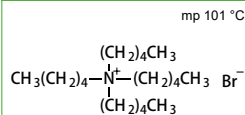
T1279 25g 250g

Tetra-butylammonium
Hexafluorophosphate
CAS RN: 3109-63-5

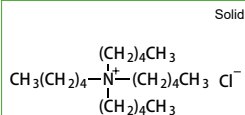
T1396 25g

Tetraheptylammonium
Iodide
CAS RN: 3535-83-9

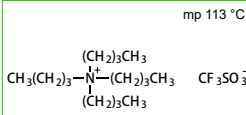
T1432 5g 25g

Tetraamylammonium
Bromide
CAS RN: 866-97-7

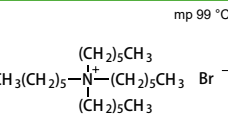
T1433 5g 25g

Tetraamylammonium
Chloride
CAS RN: 4965-17-7

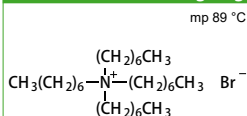
T1568 10g 25g

Tetra-butylammonium
Triflate
CAS RN: 35895-70-6

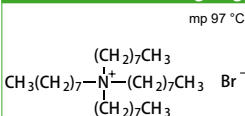
T1599 25g

Tetrahexylammonium
Bromide
CAS RN: 4328-13-6

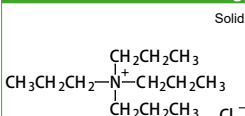
T1602 5g 25g

Tetraheptylammonium
Bromide
CAS RN: 4368-51-8

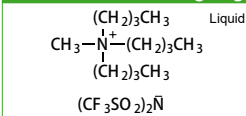
T1603 10g 25g

Tetra-*n*-octylammonium
Bromide
CAS RN: 14866-33-2

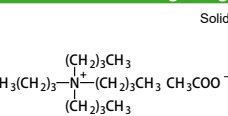
T2106 25g

Tetrapropylammonium
Chloride
CAS RN: 5810-42-4

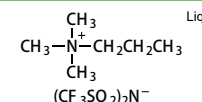
T2679 5g 25g

Tributylmethylammonium
Bis(trifluoromethanesulfonyl)-
imide
CAS RN: 405514-94-5

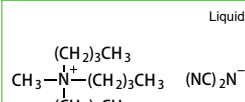
T2694 25g 100g

Tetra-butylammonium
Acetate
CAS RN: 10534-59-5

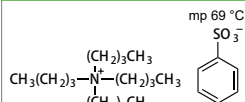
T2761 5g 25g

Trimethylpropylammonium
Bis(trifluoromethanesulfonyl)-
imide
CAS RN: 268536-05-6

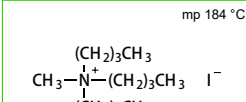
T3533 5g

Tributyl(methyl)-
ammonium Dicyanamide
CAS RN: 1262230-03-4

T3660 5g 25g

Tetra-butylammonium
p-Toluenesulfonate
CAS RN: 7182-86-7

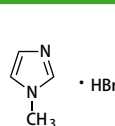
T3692 5g 25g

Tributylmethylammonium
Iodide
CAS RN: 3085-79-8

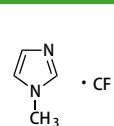
咪唑鎓盐

Imidazolium Salts

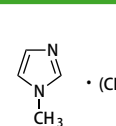
M3212 5g 25g

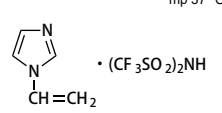
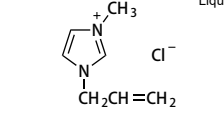
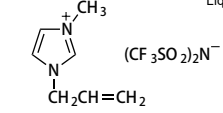
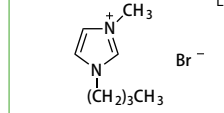
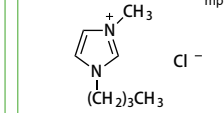
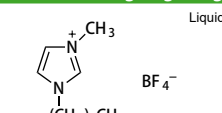
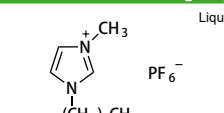
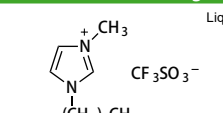
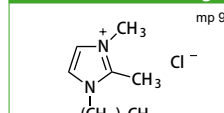
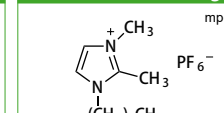
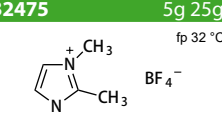
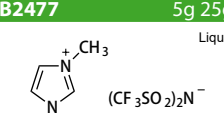
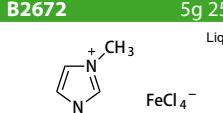
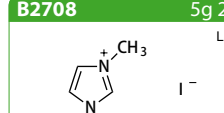
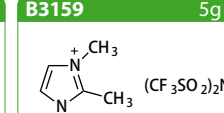
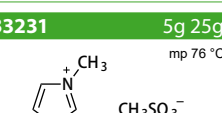
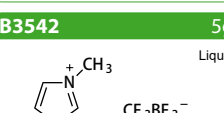
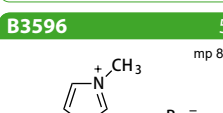
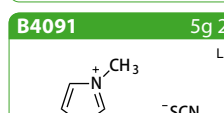
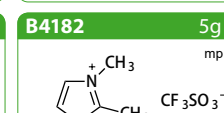
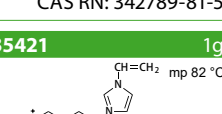
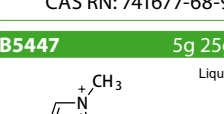
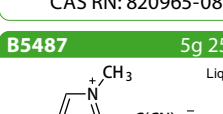
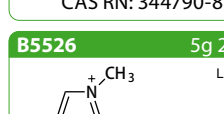
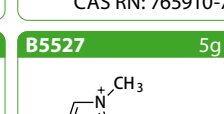
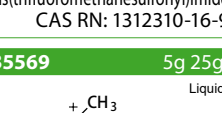
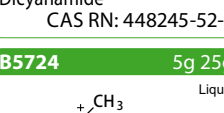
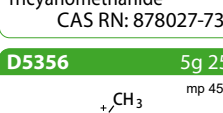
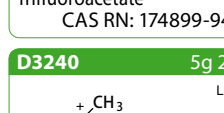
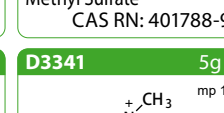
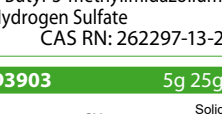
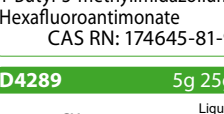
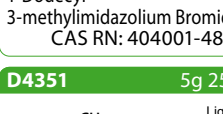
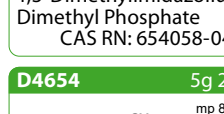
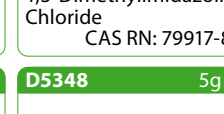
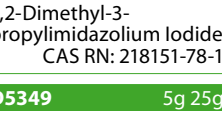
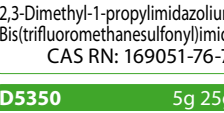
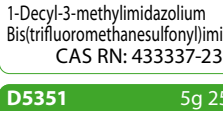
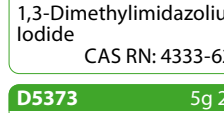
1-Methylimidazole
Hydrobromide
CAS RN: 101023-58-9

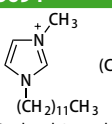
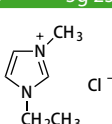
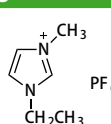
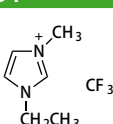
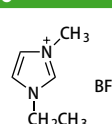
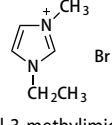
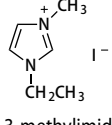
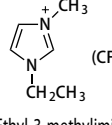
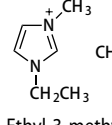
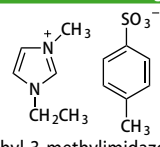
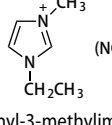
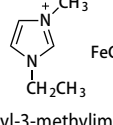
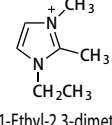
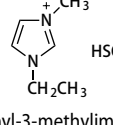
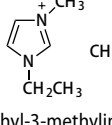
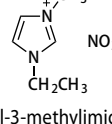
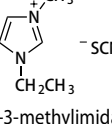
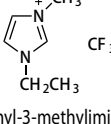
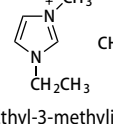
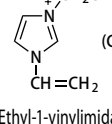
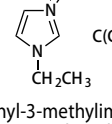
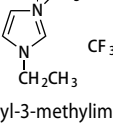
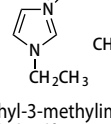
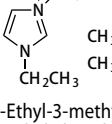
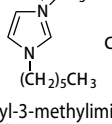
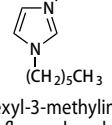
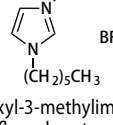
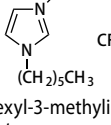
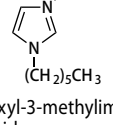
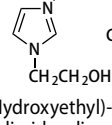
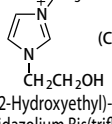
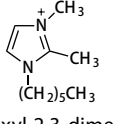
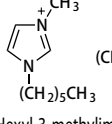
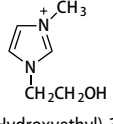
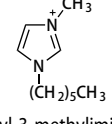
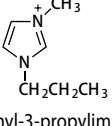
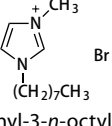
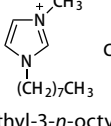
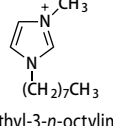
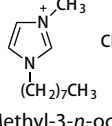
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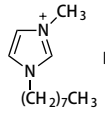
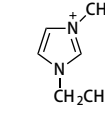
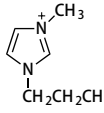
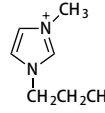
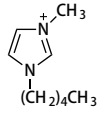
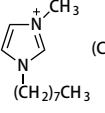
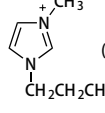
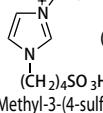
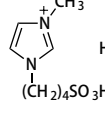
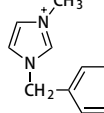
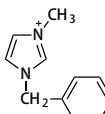
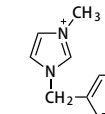
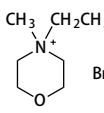
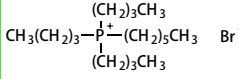
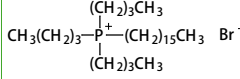
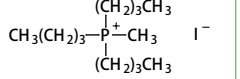
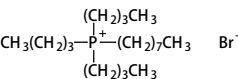
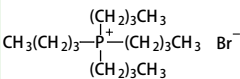
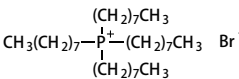
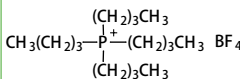
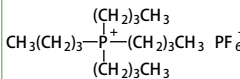
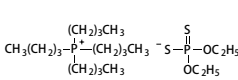
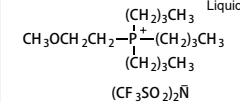
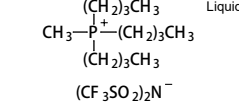
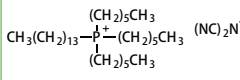
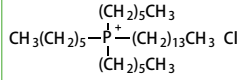
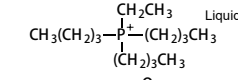
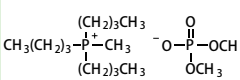
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Trifluoromethanesulfonate
CAS RN: 99257-94-0

M3210 5g 25g

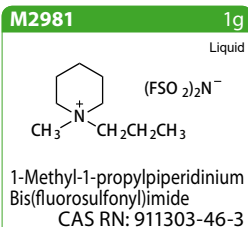
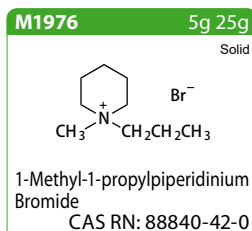
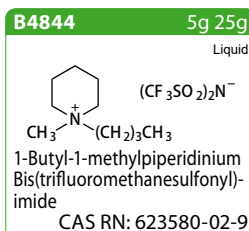
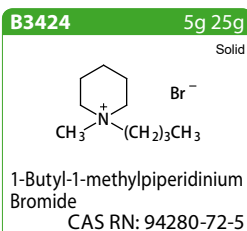
1-Methylimidazole
Bis(trifluoromethanesulfonyl)imide
CAS RN: 353239-08-4

V0145 5g mp 37 °C  1-Vinylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 1013027-27-4	A2084 5g 25g Liquid  1-Allyl-3-methylimidazolium Chloride CAS RN: 65039-10-3	A3210 5g 25g Liquid  1-Allyl-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 655249-87-9	B2193 5g Liquid  1-Butyl-3-methyl- imidazolium Bromide CAS RN: 85100-77-2	B2194 5g 25g 100g mp 41 °C  1-Butyl-3-methyl- imidazolium Chloride CAS RN: 79917-90-1
B2195 5g 25g 100g Liquid  1-Butyl-3-methylimidazolium Tetrafluoroborate CAS RN: 174501-65-6	B2320 5g 25g Liquid  1-Butyl-3-methylimidazolium Hexafluorophosphate CAS RN: 174501-64-5	B2337 5g 25g Liquid  1-Butyl-3-methylimidazolium Trifluoromethanesulfonate CAS RN: 174899-66-2	B2473 5g 25g mp 99 °C  1-Butyl-2,3-dimethyl- imidazolium Chloride CAS RN: 98892-75-2	B2474 5g 25g mp 38 °C  1-Butyl-2,3-dimethylimidazolium Hexafluorophosphate CAS RN: 227617-70-1
B2475 5g 25g fp 32 °C  1-Butyl-2,3-dimethylimidazolium Tetrafluoroborate CAS RN: 402846-78-0	B2477 5g 25g Liquid  1-Butyl-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 174899-83-3	B2672 5g 25g Liquid  1-Butyl-3-methylimidazolium Tetrachloroferrate CAS RN: 359845-21-9	B2708 5g 25g Liquid  1-Butyl-3-methylimidazolium Iodide CAS RN: 65039-05-6	B3159 5g 25g Liquid  1-Butyl-2,3-dimethylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 350493-08-2
B3231 5g 25g mp 76 °C  1-Butyl-3-methylimidazolium Methanesulfonate CAS RN: 342789-81-5	B3542 5g Liquid  1-Butyl-3-methylimidazolium Trifluoro(trifluoromethyl)borate CAS RN: 741677-68-9	B3596 5g mp 8 °C  1-Butyl-3-methylimidazolium Tribromide CAS RN: 820965-08-0	B4091 5g 25g Liquid  1-Butyl-3-methylimidazolium Thiocyanate CAS RN: 344790-87-0	B4182 5g 25g mp 44 °C  1-Butyl-2,3-dimethyl- imidazolium Triflate CAS RN: 765910-73-4
B5421 1g mp 82 °C  3,3'-(Butane-1,4-diyl)- bis(1-vinyl-3-imidazolium)- Bis(trifluoromethanesulfonyl)imide CAS RN: 1312310-16-9	B5447 5g 25g Liquid  1-Butyl-3-methylimidazolium Dicyanamide CAS RN: 448245-52-1	B5487 5g 25g Liquid  1-Butyl- 3-methylimidazolium Tricyanomethanide CAS RN: 878027-73-7	B5526 5g 25g Liquid  1-Butyl- 3-methylimidazolium Trifluoroacetate CAS RN: 174899-94-6	B5527 5g 25g Liquid  1-Butyl-3-methylimidazolium Methyl Sulfate CAS RN: 401788-98-5
B5569 5g 25g Liquid  1-Butyl-3-methylimidazolium Hydrogen Sulfate CAS RN: 262297-13-2	B5724 5g 25g Liquid  1-Butyl-3-methylimidazolium Hexafluoroantimonate CAS RN: 174645-81-9	D5356 5g 25g mp 45 °C  1-Dodecyl- 3-methylimidazolium Bromide CAS RN: 404001-48-5	D3240 5g 25g Liquid  1,3-Dimethylimidazolium Dimethyl Phosphate CAS RN: 654058-04-5	D3341 5g 25g mp 125 °C  1,3-Dimethylimidazolium Chloride CAS RN: 79917-88-7
D3903 5g 25g Solid  1,2-Dimethyl-3- propylimidazolium Iodide CAS RN: 218151-78-1	D4289 5g 25g Liquid  2,3-Dimethyl-1-propylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 169051-76-7	D4351 5g 25g Liquid  1-Decyl-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 433337-23-6	D4654 5g 25g mp 86 °C  1,3-Dimethylimidazolium Iodide CAS RN: 4333-62-4	D5348 5g 25g Liquid  1,3-Dimethylimidazolium Methyl Sulfate CAS RN: 97345-90-9
D5349 5g 25g Solid  1,3-Dimethylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 174899-81-1	D5350 5g 25g Liquid  1-Decyl-3-methylimidazolium Bromide CAS RN: 188589-32-4	D5351 5g 25g Liquid  1-Decyl-3-methylimidazolium Chloride CAS RN: 171058-18-7	D5373 5g 25g Liquid  1-Decyl-3-methylimidazolium Tetrafluoroborate CAS RN: 244193-56-4	

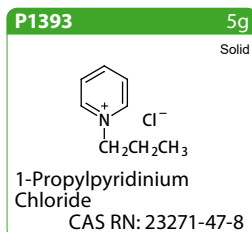
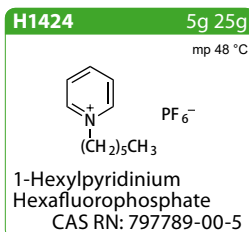
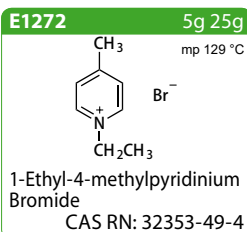
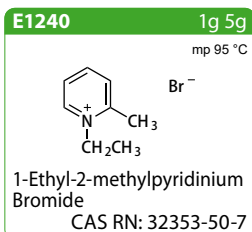
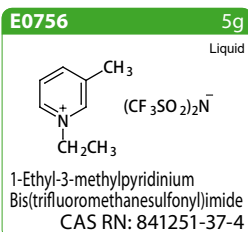
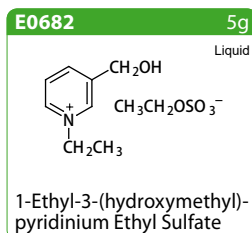
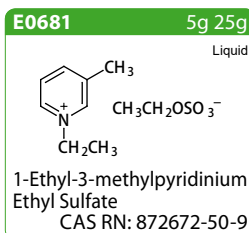
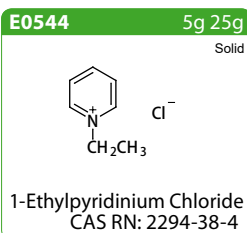
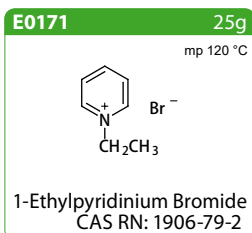
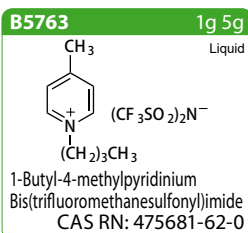
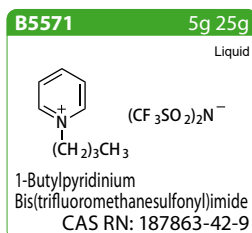
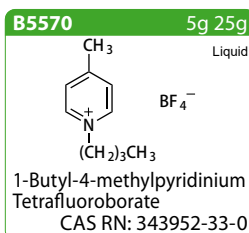
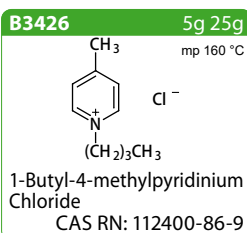
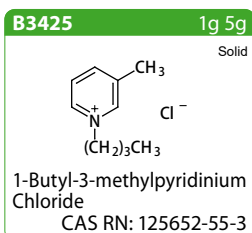
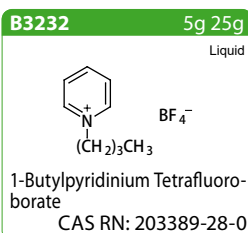
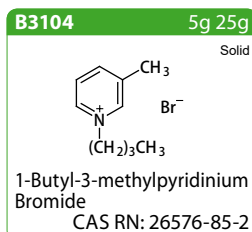
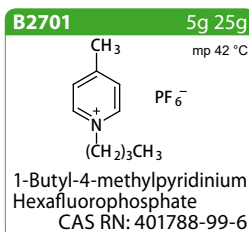
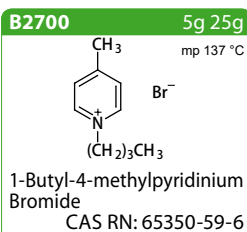
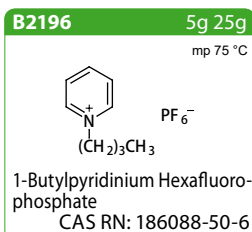
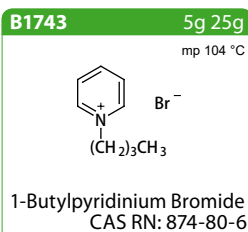
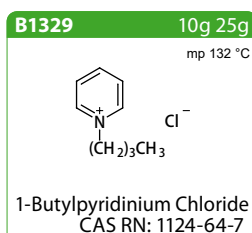
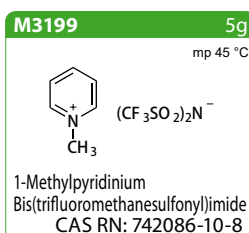
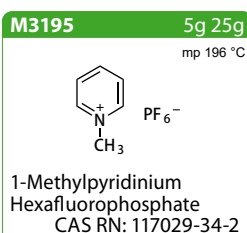
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<p>E0543 5g 25g mp 74 °C</p>  <p>Br⁻</p> <p>1-Ethyl-3-methylimidazolium Bromide CAS RN: 65039-08-9</p>	<p>E0556 5g 25g mp 79 °C</p>  <p>I⁻</p> <p>1-Ethyl-3-methylimidazolium Iodide CAS RN: 35935-34-3</p>	<p>E0599 5g 25g Liquid</p>  <p>(CF₃SO₂)₂N⁻</p> <p>1-Ethyl-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 174899-82-2</p>	<p>E0650 5g 25g Liquid</p>  <p>CH₃CH₂OSO₃⁻</p> <p>1-Ethyl-3-methylimidazolium Ethyl Sulfate CAS RN: 342573-75-5</p>	<p>E0651 5g 25g Solid</p>  <p>SO₃⁻ Solid</p> <p>1-Ethyl-3-methylimidazolium <i>p</i>-Toluenesulfonate CAS RN: 328090-25-1</p>
<p>E0680 1g 5g Liquid</p>  <p>(NC)₂N⁻</p> <p>1-Ethyl-3-methylimidazolium Dicyanamide CAS RN: 370865-89-7</p>	<p>E0706 5g Liquid</p>  <p>FeCl₄⁻</p> <p>1-Ethyl-3-methylimidazolium Tetrachloroferrate CAS RN: 850331-04-3</p>	<p>E0753 5g 25g Liquid</p>  <p>(CF₃SO₂)₂N⁻</p> <p>1-Ethyl-2,3-dimethylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 174899-90-2</p>	<p>E0754 5g Liquid</p>  <p>HSO₄⁻</p> <p>1-Ethyl-3-methylimidazolium Hydrogen Sulfate CAS RN: 412009-61-1</p>	<p>E0755 5g 25g Liquid</p>  <p>CH₃SO₃⁻</p> <p>1-Ethyl-3-methylimidazolium Methanesulfonate CAS RN: 145022-45-3</p>
<p>E0775 5g 25g Solid</p>  <p>NO₃⁻</p> <p>1-Ethyl-3-methylimidazolium Nitrate CAS RN: 143314-14-1</p>	<p>E0776 5g 25g Liquid</p>  <p>SCN⁻</p> <p>1-Ethyl-3-methylimidazolium Thiocyanate CAS RN: 331717-63-6</p>	<p>E0836 5g Liquid</p>  <p>CF₃BF₃⁻</p> <p>1-Ethyl-3-methylimidazolium Trifluoro(trifluoromethyl)borate CAS RN: 681856-28-0</p>	<p>E0883 5g 25g Liquid</p>  <p>CH₃CO₂⁻</p> <p>1-Ethyl-3-methylimidazolium Acetate CAS RN: 143314-17-4</p>	<p>E1280 5g Liquid</p>  <p>(CF₃SO₂)₂N⁻</p> <p>3-Ethyl-1-vinylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 319476-28-3</p>
<p>E1298 5g 25g Liquid</p>  <p>C(CN)₃⁻</p> <p>1-Ethyl-3-methylimidazolium Tricyanomethanide CAS RN: 666823-18-3</p>	<p>E1307 5g 25g Liquid</p>  <p>CF₃CO₂⁻</p> <p>1-Ethyl-3-methylimidazolium Trifluoroacetate CAS RN: 174899-65-1</p>	<p>E1308 5g 25g Liquid</p>  <p>CH₃SO₄⁻</p> <p>1-Ethyl-3-methylimidazolium Methyl Sulfate CAS RN: 516474-01-4</p>	<p>E1309 5g 25g Liquid</p>  <p>CH₃CH₂O-P(=O)(O⁻)-CH₃CH₂O⁻</p> <p>1-Ethyl-3-methylimidazolium Diethyl Phosphate CAS RN: 848641-69-0</p>	<p>H1097 5g 25g Liquid</p>  <p>Cl⁻</p> <p>1-Hexyl-3-methylimidazolium Chloride CAS RN: 171058-17-6</p>
<p>H1098 5g 25g Liquid</p>  <p>PF₆⁻</p> <p>1-Hexyl-3-methylimidazolium Hexafluorophosphate CAS RN: 304680-35-1</p>	<p>H1099 5g 25g Liquid</p>  <p>BF₄⁻</p> <p>1-Hexyl-3-methylimidazolium Tetrafluoroborate CAS RN: 244193-50-8</p>	<p>H1100 5g Liquid</p>  <p>CF₃SO₃⁻</p> <p>1-Hexyl-3-methylimidazolium Triflate CAS RN: 460345-16-8</p>	<p>H1227 5g 25g Liquid</p>  <p>Br⁻</p> <p>1-Hexyl-3-methylimidazolium Bromide CAS RN: 85100-78-3</p>	<p>H1254 5g 25g mp 83 °C</p>  <p>Cl⁻</p> <p>1-(2-Hydroxyethyl)-3-methylimidazolium Chloride CAS RN: 61755-34-8</p>
<p>H1670 5g 25g Liquid</p>  <p>(CF₃SO₂)₂N⁻</p> <p>1-(2-Hydroxyethyl)-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 174899-86-6</p>	<p>H1286 5g Solid</p>  <p>I⁻</p> <p>1-Hexyl-2,3-dimethylimidazolium Iodide CAS RN: 288627-94-1</p>	<p>H1423 5g 25g Liquid</p>  <p>(CF₃SO₂)₂N⁻</p> <p>1-Hexyl-3-methylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 382150-50-7</p>	<p>H1492 5g 25g Liquid</p>  <p>BF₄⁻</p> <p>1-(2-Hydroxyethyl)-3-methylimidazolium Tetrafluoroborate CAS RN: 374564-83-7</p>	<p>H1633 5g 25g Liquid</p>  <p>I⁻</p> <p>1-Hexyl-3-methylimidazolium Iodide CAS RN: 178631-05-5</p>
<p>M1440 5g 25g Liquid</p>  <p>I⁻</p> <p>1-Methyl-3-propylimidazolium Iodide CAS RN: 119171-18-5</p>	<p>M1904 5g 25g Liquid</p>  <p>Br⁻</p> <p>1-Methyl-3-<i>n</i>-octylimidazolium Bromide CAS RN: 61545-99-1</p>	<p>M2062 5g 25g Liquid</p>  <p>Cl⁻</p> <p>1-Methyl-3-<i>n</i>-octylimidazolium Chloride CAS RN: 64697-40-1</p>	<p>M2063 5g 25g Liquid</p>  <p>PF₆⁻</p> <p>1-Methyl-3-<i>n</i>-octylimidazolium Hexafluorophosphate CAS RN: 304680-36-2</p>	<p>M2440 5g 25g Liquid</p>  <p>CF₃SO₃⁻</p> <p>1-Methyl-3-<i>n</i>-octylimidazolium Triflate CAS RN: 403842-84-2</p>

M2732 5g 25g  1-Methyl-3- <i>n</i> -octylimidazolium Tetrafluoroborate CAS RN: 244193-52-0	M3034 5g 25g  1-Methyl-3-propylimidazolium Bromide CAS RN: 85100-76-1	M3035 5g 25g mp 64 °C  1-Methyl-3-propylimidazolium Chloride CAS RN: 79917-89-8	M3036 5g 25g  1-Methyl-3-propylimidazolium Tetrafluoroborate CAS RN: 244193-48-4	M3037 5g 25g  1-Methyl-3-pentylimidazolium Bromide CAS RN: 343851-31-0		
M3039 5g 25g  1-Methyl-3- <i>n</i> -octylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 178631-04-4	M3059 5g 25g  1-Methyl-3-propylimidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 216299-72-8	M3119 1g 5g  1-Methyl-3-(4-sulfobutyl)-imidazolium Bis(trifluoromethanesulfonyl)imide CAS RN: 909390-59-6	M3120 5g 25g  1-Methyl-3-(4-sulfobutyl)-imidazolium Hydrogen Sulfate CAS RN: 827320-59-2	B5543 5g 25g  1-Benzyl-3-methylimidazolium Chloride CAS RN: 36443-80-8		
B5725 5g 25g mp 62 °C  1-Benzyl-3-methylimidazolium Tetrafluoroborate CAS RN: 500996-04-3	B5726 5g 25g mp 132 °C  1-Benzyl-3-methylimidazolium Hexafluorophosphate CAS RN: 433337-11-2	<div style="background-color: #008000; color: white; padding: 10px; text-align: center;"> <h2 style="margin: 0;">吗啉鎓盐</h2> <h3 style="margin: 0;">Morpholinium Salts</h3> </div>				
<div style="background-color: #008000; color: white; padding: 10px; text-align: center;"> <h2 style="margin: 0;">鏷盐</h2> <h3 style="margin: 0;">Phosponium Salts</h3> </div>			E1166 5g 25g mp 177 °C  4-Ethyl-4-methylmorpholinium Bromide CAS RN: 65756-41-4	T3840 5g 25g  Tributylhexylphosphonium Bromide CAS RN: 105890-71-9	H1047 25g mp 61 °C  Tributylhexadecylphosphonium Bromide CAS RN: 14937-45-2	M1455 5g 25g  Tributylmethylphosphonium Iodide CAS RN: 1702-42-7
O0297 25g Solid  Tributyl- <i>n</i> -octylphosphonium Bromide CAS RN: 57702-65-5	T1124 25g 100g 500g mp 104 °C  Tetrabutylphosphonium Bromide CAS RN: 3115-68-2	T1650 25g mp 42 °C  Tetra- <i>n</i> -octylphosphonium Bromide CAS RN: 23906-97-0	T2006 25g mp 95 °C  Tetrabutylphosphonium Tetrafluoroborate CAS RN: 1813-60-1	T2007 5g 25g Solid  Tetrabutylphosphonium Hexafluorophosphate CAS RN: 111928-21-3		
T3946 25g 100g Liquid  Tetrabutylphosphonium O,O-Diethyl Phosphorodithioate CAS RN: 96131-57-6	T2564 5g 25g Liquid  Tributyl(2-methoxyethyl)-phosphonium Bis(trifluoromethanesulfonyl)imide CAS RN: 959698-44-3	T2680 5g Liquid  Tributylmethylphosphonium Bis(trifluoromethanesulfonyl)imide CAS RN: 324575-10-2	T3534 5g 25g Liquid  Trihexyl(tetradecyl)-phosphonium Dicyanamide CAS RN: 701921-71-3	T3623 5g 25g Liquid  Trihexyl(tetradecyl)-phosphonium Chloride CAS RN: 258864-54-9		
T3641 5g 25g Liquid  Tributyl(ethyl)phosphonium Diethyl Phosphate CAS RN: 20445-94-7	T3945 25g 100g mp 17 °C  Tributyl(methyl)phosphonium Dimethyl Phosphate CAS RN: 20445-88-9					

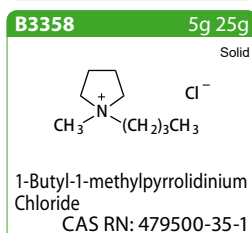
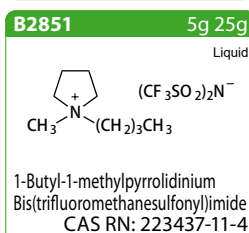
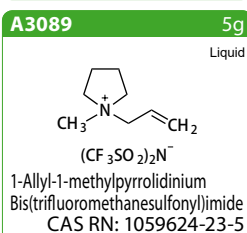
哌啶鎓盐 Piperidinium Salts

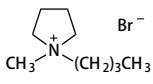
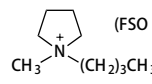
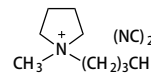
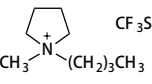
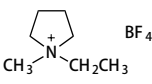
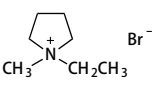
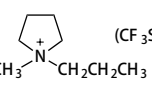
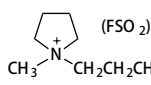
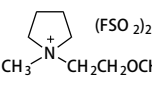
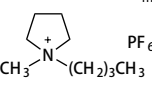
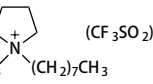
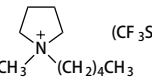
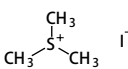
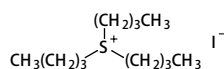
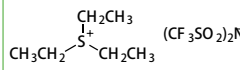


吡啶鎓盐 Pyridinium Salts



吡咯烷鎓盐 Pyrrolidinium Salts



B3427 5g 25g Solid  1-Butyl-1-methylpyrrolidinium Bromide CAS RN: 93457-69-3	B5398 5g Liquid  1-Butyl-1-methylpyrrolidinium Bis(fluorosulfonyl)imide CAS RN: 1057745-51-3	B5453 5g 25g Liquid  1-Butyl-1-methylpyrrolidinium Dicyanamide CAS RN: 370865-80-8	B5568 5g 25g Liquid  1-Butyl-1-methylpyrrolidinium Triflate CAS RN: 367522-96-1	E0977 5g 25g Solid  1-Ethyl-1-methylpyrrolidinium Tetrafluoroborate CAS RN: 117947-85-0
E1050 5g 25g Solid  1-Ethyl-1-methylpyrrolidinium Bromide CAS RN: 69227-51-6	M2098 5g 25g Liquid  1-Methyl-1-propylpyrrolidinium Bis(trifluoromethanesulfonyl)imide CAS RN: 223437-05-6	M2980 5g Liquid  1-Methyl-1-propylpyrrolidinium Bis(fluorosulfonyl)imide CAS RN: 852620-97-4	M2998 1g 5g Liquid  1-(2-Methoxyethyl)-1-methylpyrrolidinium Bis(fluorosulfonyl)imide CAS RN: 1235234-47-5	B6039 5g 25g mp 86 °C  1-Butyl-1-methylpyrrolidinium Hexafluorophosphate CAS RN: 330671-29-9
M3117 5g 25g mp -12 °C  1-Methyl-1-n-octylpyrrolidinium Bis(trifluoromethanesulfonyl)imide CAS RN: 927021-43-0	M3118 1g 5g mp 8 °C  1-Methyl-1-pentylpyrrolidinium Bis(trifluoromethanesulfonyl)imide CAS RN: 380497-17-6	<div style="background-color: #008000; color: white; padding: 10px; text-align: center;"> <h2 style="margin: 0;">鎍盐</h2> <h3 style="margin: 0;">Sulfonium Salts</h3> </div>		
T1056 25g 500g Solid  Trimethylsulfonium Iodide CAS RN: 2181-42-2			T1564 1g mp 93 °C  Tributylsulfonium Iodide CAS RN: 18146-62-8	T2314 5g Liquid  Triethylsulfonium Bis(trifluoromethanesulfonyl)imide CAS RN: 321746-49-0

熔点仅为参考值，不是规格值。
室温下形成液态或固态的盐被称为“液体”或“固体”。



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