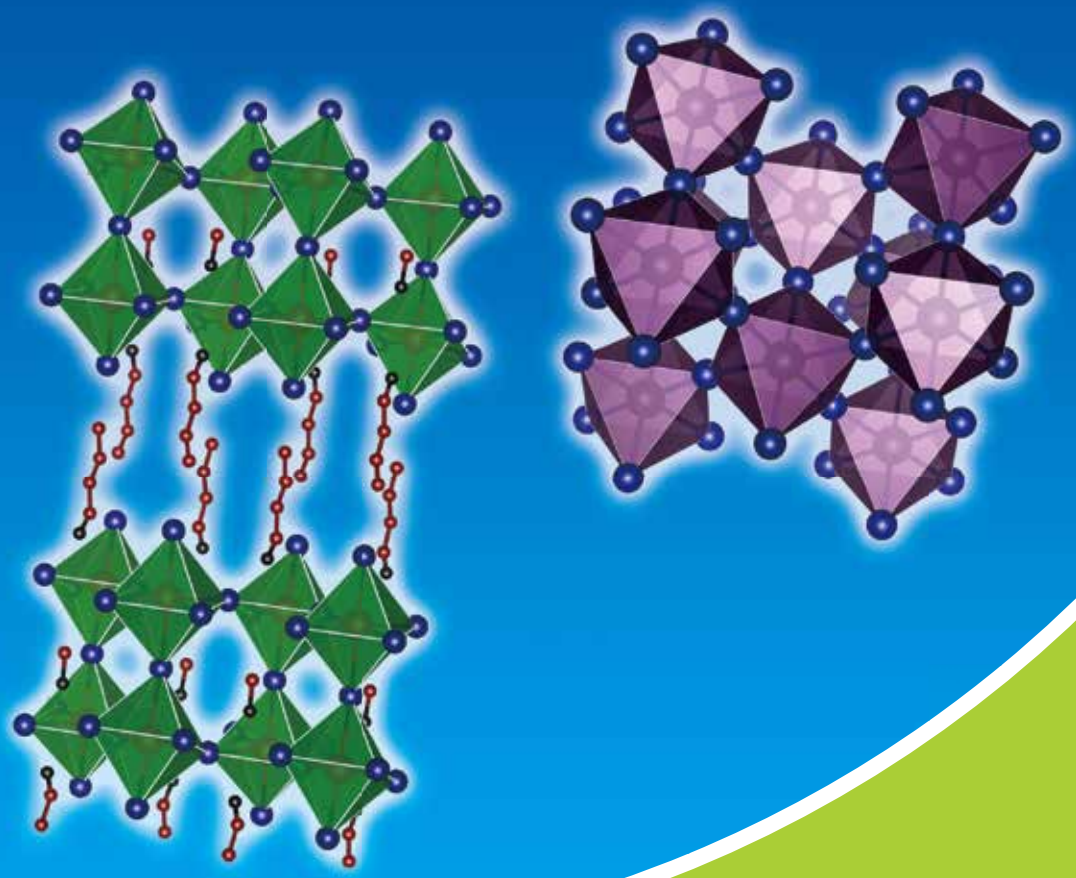
有机–无机钙钛矿前体

Organic-Inorganic Perovskite Precursors



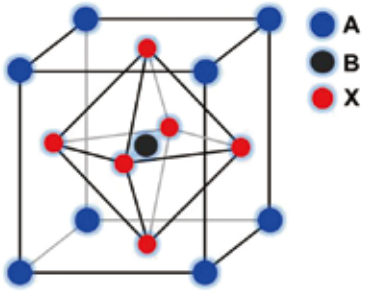
卤化铅

有机鎓盐

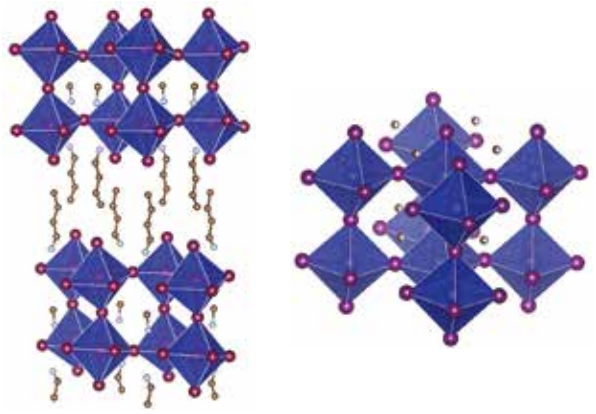
卤化铯

有机–无机钙钛矿前体

"钙钛矿"源于钛酸钙($CaTiO_3$)的矿物名，它是一类分子通式为ABX_3的化合物，其中，A代表二价金属离子，B代表四价金属离子。立方相或正交相的钙钛矿呈现出铁电性，比如，钛酸钡($BaTiO_3$)就是一种铁电或压电材料[1]。所有钙钛矿化合物中，都含有以铜氧化物为结构单元的高温超导氧化物[2]。这些钙钛矿化合物由金属离子和氧原子组成，通过物理方法制造（如烧结法）[3]。对金属离子进行修饰，以及改变金属离子的比例，可以控制钙钛矿的物理性质。除了氧化物型钙钛矿，卤化物型钙钛矿也十分常见。



另一方面，可以用有机铵替代A位上的阳离子。这样即用化学方法得到了一种钙钛矿化合物。这种钙钛矿化合物含有有机组分，因此被称为"有机-无机钙钛矿化合物"。其中的金属离子通常为锡或铅[4,5]。此类钙钛矿化合物的分子通式为[$(RNH_3)_mMX_n$]，通过对金属(M)、卤素(X)以及有机基团(R)的修饰，可以对其物理性质进行精确控制。其中，锡钙钛矿的导电性相对较好[6]，而铅钙钛矿的光学特性则相对更好[7]。另外，对卤素进行化学修饰还可以控制带隙[8]。不同的卤化鎓盐、金属卤化物，及其混合的比例，都可以改变卤素的构成比例。有机基团(R)通常为甲基、长链烷基、苯基、苄基、苯乙基等。有机基团的不同控制着钙钛矿化合物的结构。例如，R=甲基的钙钛矿化合物[$(MeNH_3)MX_3$]，具有三维立方结构[9]。而R=CnH2n+1(n≥2)的钙钛矿化合物，呈二维层状结构，并且烷基的长度可以改变层间的距离[10]。



钙钛矿太阳能电池是有机-无机钙钛矿的应用之一[11-15]，其可以利用三维立方钙钛矿[$(MeNH_3)MX_3$]制备。钙钛矿太阳能电池的研究中也包括了甲脒阳离子[16]和铯阳离子[17]对A位的掺杂效应。Wakamiya等人最近开发出一种即用型钙钛矿前体，$MeNH_3I/PbI_2$-DMF复合物，通过溶液法可以构造出一种非常统一的晶状薄膜[18]。近来，对钙钛矿太阳能电池的研究引起了众多关注。这类太阳能电池的光电转化效率高于其它的有机太阳能电池(OPV)和染料敏化太阳能电池(DSSC)，并且利用溶液法即可低成本的进行制造。

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卤化铅
Lead Halides

L0279 1g 5g 25g 100g
PbI_2
Lead(II) Iodide (99.99%, trace metals basis) [10101-63-0]

P2415 1g 5g 25g
$CH_3NH_3PbI_3$ / DMF
PbI_2/MAI(1:1) - DMF Complex (99.99%, trace metals basis)

L0288 1g 5g 25g
$PbBr_2$
Lead(II) Bromide [10031-22-8]

L0292 1g 5g 25g
$PbCl_2$
Lead(II) Chloride [7758-95-4]

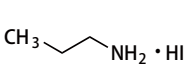
L0291 1g 5g
$PbCl_2$
Lead(II) Chloride (purified by sublimation) [7758-95-4]

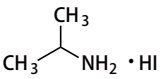
有机鎓盐
Organic Onium Salts

碘化盐
Iodide Salts

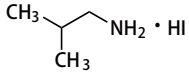
M2556 1g 5g 25g
$CH_3NH_2 \cdot HI$
Methylamine Hydroiodide [14965-49-2]

E1045 1g 5g
$CH_3CH_2NH_2 \cdot HI$
Ethylamine Hydroiodide [506-58-1]

P2212 1g 5g

Propylamine Hydroiodide [14488-45-0]

I0934 1g 5g

Isopropylamine Hydroiodide [66735-20-4]

B4433 1g 5g
$CH_3(CH_2)_3NH_2 \cdot HI$
Butylamine Hydroiodide [36945-08-1]

I0935 1g 5g

Isobutylamine Hydroiodide [205508-75-4]

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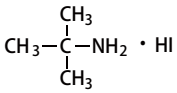
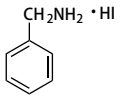
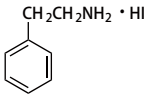
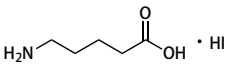

tert-Butylamine Hydroiodide [39557-45-4]

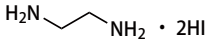
A2778 1g 5g

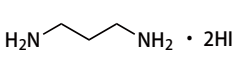
Aniline Hydroiodide [45497-73-2]

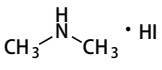
B4566 1g 5g

Benzylamine Hydroiodide [45579-91-7]

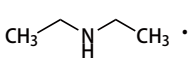
P2213 1g 5g

2-Phenylethylamine Hydroiodide [151059-43-7]

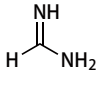
A2984 1g 5g

5-Aminovaleric Acid Hydroiodide [1705581-28-7]

E1222 1g 5g 25g

Ethylenediamine Dihydroiodide [5700-49-2]

D5091 1g 5g

1,3-Diaminopropane Dihydroiodide [120675-53-8]

D4555 1g 5g

Dimethylamine Hydroiodide [51066-74-1]

D4643 1g 5g

Diethylamine Hydroiodide [19833-78-4]

F0974 1g 5g

Formamidine Hydroiodide [879643-71-7]

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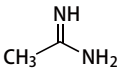
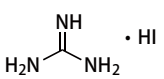
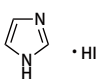
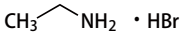

Acetamidine Hydroiodide [1452099-14-7]

G0450 1g 5g

Guanidine Hydroiodide [19227-70-4]

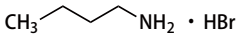
I0970 1g 5g

Imidazole Hydroiodide [68007-08-9]

溴化盐
Bromide Salts

M2589 1g 5g
$CH_3NH_2 \cdot HBr$
Methylamine Hydrobromide [6876-37-5]

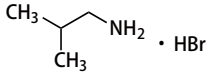
E0056 25g 500g

Ethylamine Hydrobromide [593-55-5]

B5186 1g 5g



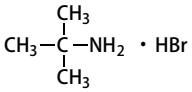
Butylamine Hydrobromide [15567-09-6]

I1007 1g 5g



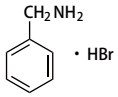
Isobutylamine Hydrobromide [74098-36-5]

B5187 1g 5g



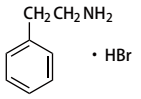
tert-Butylamine Hydrobromide [60469-70-7]

B5185 1g 5g



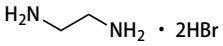
Benzylamine Hydrobromide [37488-40-7]

P2388 1g 5g



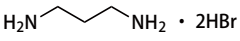
2-Phenylethylamine Hydrobromide [53916-94-2]

E1221 1g 5g



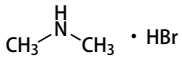
Ethylenediamine Dihydrobromide [624-59-9]

D5090 1g 5g



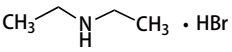
1,3-Diaminopropane Dihydrobromide [18773-03-0]

D5092 1g 5g



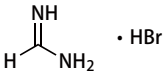
Dimethylamine Hydrobromide [6912-12-5]

D4667 1g 5g



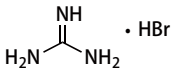
Diethylamine Hydrobromide [6274-12-0]

F0973 1g 5g



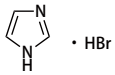
Formamidine Hydrobromide [146958-06-7]

G0449 1g 5g



Guanidine Hydrobromide [19244-98-5]

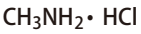
I1006 1g 5g



Imidazole Hydrobromide [101023-55-6]

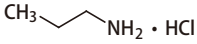
氯化盐
Chloride Salts

M0138 25g 500g



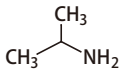
Methylamine Hydrochloride [593-51-1]

P0522 25g



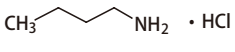
Propylamine Hydrochloride [556-53-6]

I0166 25g 100g 500g



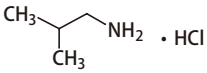
Isopropylamine Hydrochloride [15572-56-2]

B0710 25g 500g



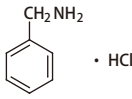
Butylamine Hydrochloride [3858-78-4]

I0096 25g 500g



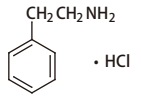
Isobutylamine Hydrochloride [5041-09-8]

B0407 25g 100g 500g



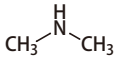
Benzylamine Hydrochloride [3287-99-8]

P0086 25g 100g 500g



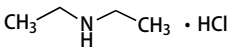
2-Phenylethylamine Hydrochloride [156-28-5]

D0644 25g 500g



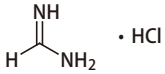
Dimethylamine Hydrochloride [506-59-2]

D0468 25g 500g



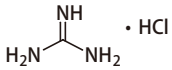
Diethylamine Hydrochloride [660-68-4]

F0103 5g 25g



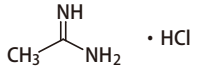
Formamidine Hydrochloride [6313-33-3]

G0162 25g 500g



Guanidine Hydrochloride [50-01-1]

A0008 25g 500g



Acetamidine Hydrochloride [124-42-5]

卤化铯
Cesium Halides

C2205 25g

CsI

Cesium Iodide [7789-17-5]

C2202 25g

CsBr

Cesium Bromide [7787-69-1]

C2203 25g 100g

CsCl

Cesium Chloride [7647-17-8]

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