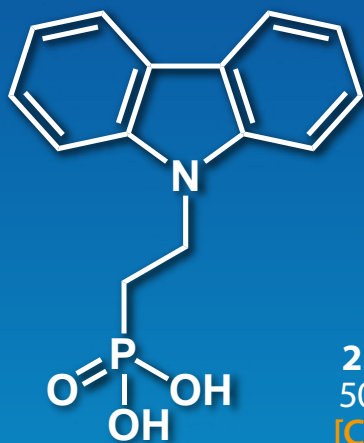


New

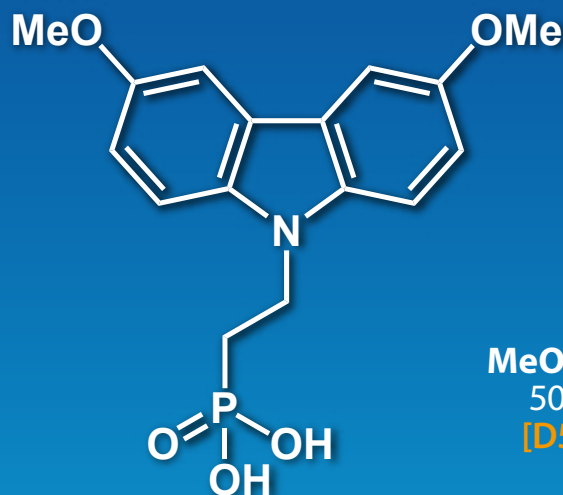
MATERIALS



For Highly Efficient Perovskite Solar Cells, Hole-Selective, Self-Assembled Monolayer (SAM)-Forming Agents



2PACz
500mg
[C3663]

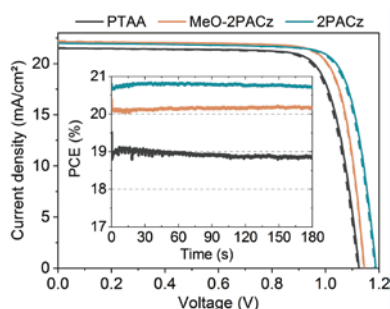
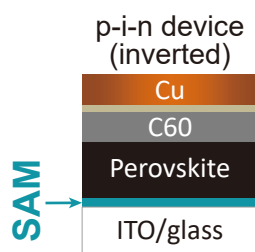


MeO-2PACz
500mg
[D5798]

Advantages

- Enable efficient, versatile and stable p-i-n perovskite solar cell devices (> 21 % PCE without additives, interlayers or dopants)
- Self-assembly leads to conformal coverage of oxide surfaces (including textured)
- Simple, scalable and extremely cost-effective processing

Application



Efficiency on 1 cm² = **23.26%**



SAM
oxide

World-record CIGSe/perovskite tandem enabled by conformal SAM

Stabilized power conversion efficiencies with self-assembled monolayer (SAM):

Perovskite SAM	CsMAFA ("triple cation")	MAFA	Co-evaporated MAPbI ₃	CIGSe/CsMAFA tandem
2PACz	20.8%	21.1%	-	-
MeO-2PACz	20.2%	21.1%	19.6%	23.26%, certified

(CsMAFA = Cs_{0.05}(MA_{0.17}FA_{0.83})_{0.95}Pb(I_{0.83}Br_{0.17})₃, MAFA = MA_{0.05}FA_{0.95}Pb(I_{0.95}Br_{0.05})₃, Cs = cesium, MA = methylammonium, FA = formamidinium, CIGSe = copper indium gallium selenide)

*These data are from Reference (A. Al-Ashouri, S. Albrecht, et al., *Energy Environ. Sci.* **2019**, 12, 3356. DOI: 10.1039/C9EE02268F).

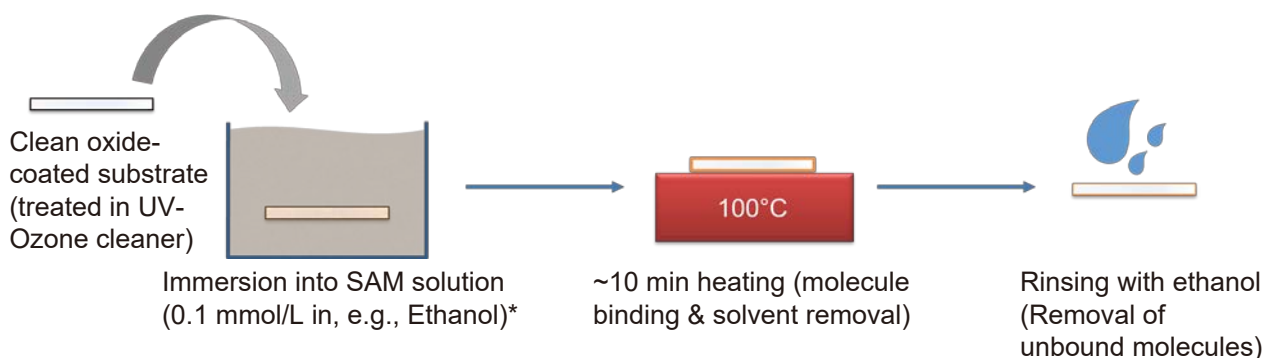
The 2PACz and MeO-2PACz materials are covered by a joint patent pending (PCT/EP2019/060586) of Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Germany and Kaunas University of Technology, Lithuania. TCI has been granted the right to manufacture and sell these materials.

For Highly Efficient Perovskite Solar Cells, Hole-Selective, Self-Assembled Monolayer (SAM)-Forming Agents

Processing

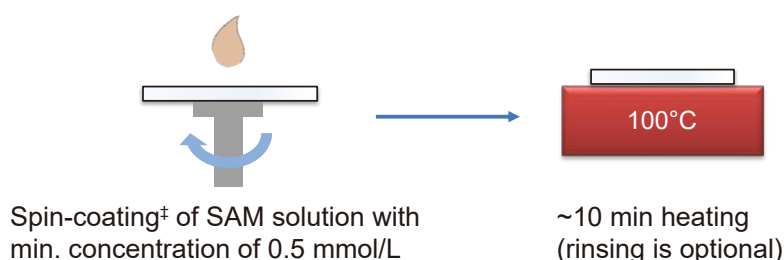
Method 1: Dip coating

suitable for large-area coating and textured substrates



Method 2: Spin coating

suitable for fast research & optimization



* Depending on the used concentration, the minimum needed dipping time can vary from minutes to hours. As a starting point: e.g., 0.1 mmol/L and 1 h dipping at room temperature.

- The SAMs can be processed within wide processing windows with higher reproducibility than current standard hole transport materials (like PTAA). The substrates (e.g. ITO) have to be clean and activated by, for example, UV-Ozone treatment.
- The SAM powders were usually dissolved in ethanol or isopropanol (1 mmol/L \approx 0.3 mg/mL), MeO-2PACz powder was stored in air, while 2PACz was stored in a N₂-filled glovebox.

[‡]For more details, see Supp. Info. of *Energy Environ. Sci.* **2019**, *12*, 3356. (DOI: 10.1039/C9EE02268F)

*These data are provided by Prof. Steve Albrecht and Prof. Vytautas Getautis.

For further information please refer to our website at www.TCIchemicals.com.

solar cell



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TOKYO CHEMICAL INDUSTRY CO., LTD.

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