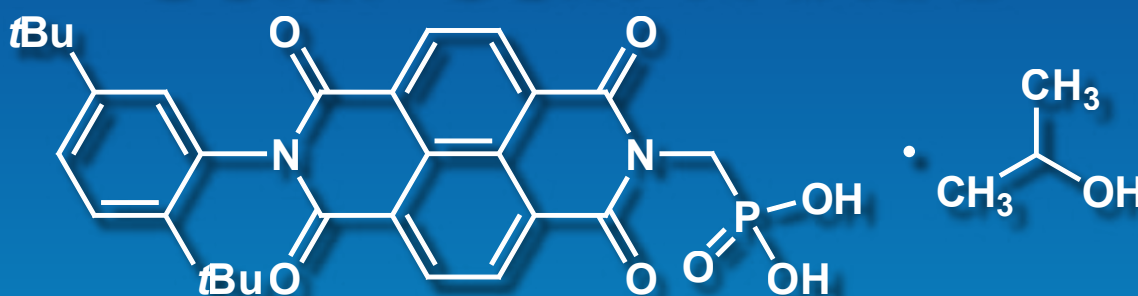


# n-Type SAM Forming Agent Enabling Efficient Perovskite Solar Cell: PANDI



PANDI Isopropyl Alcohol Adduct

500mg

[P3307]

## Advantages

- Enables the highest level of conversion efficiency for perovskite solar cells (n-i-p type device) using n-type SAMs (electron selective self-assembled monolayers)
- Usable as alternatives of electron transport layers (ETLs) such as TiO<sub>2</sub> and SnO<sub>2</sub>
- Enables uniform covering on metal oxide surfaces
- Enables device fabrication by low temperature process, allowing use of flexible plastic substrates
- Enables simultaneously reducing optical reflectance and interfacial energetic losses

## Perovskite solar cell performances using n-type SAM forming agents (SAM = self-assembled monolayer)

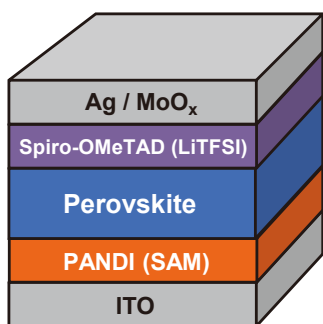
n-Type SAM	J <sub>sc</sub> (mA/cm <sup>2</sup> )	V <sub>oc</sub> (V)	FF (%)	PCE (%)	Solar cell architecture	Ref.
PANDI [P3307]	24.7	1.13	77.1	21.5	ITO/PANDI/CsFAMAPbI <sub>3</sub> /Spiro-OMeTAD/MoO <sub>x</sub> /Ag	1)
PANDI [P3307]	23.4	0.99	75.6	17.7	Flexible substrate ITO-PET/PANDI/CsMAFAPbI <sub>2</sub> Br/Spiro-OMeTAD/Ag	1)
PAAQ	24.1	1.03	72.1	17.8	ITO/PAAQ/CsFAMAPbI <sub>3</sub> /Spiro-OMeTAD/MoO <sub>x</sub> /Ag	1)
NMI-SAM	20.0	1.03	62.0	12.6	ITO/NMI-SAM/CsMAFAPbI <sub>2</sub> Br/HTM/Au	2)
C <sub>60</sub> -SAM	21.4	1.06	77.0	19.0	ITO/C <sub>60</sub> -SAM/FA <sub>0.83</sub> MA <sub>0.17</sub> Pb <sub>1.1</sub> Br <sub>0.50</sub> I <sub>2.80</sub> /PDCBT/ Ta-WO <sub>x</sub> /Au	3)
PCBDAN-SAM	21.7	1.08	77.3	18.1	ITO/PCBDAN-SAM/PCBM/MAPbI <sub>3</sub> /Spiro-OMeTAD/Au	4)

- References**
- 1) D. S. Utomo, L. M. Svirskaitė, A. Musiienko, V. Getautis, T. Malinauskas, R. Azmi, S. De Wolf, *et al.*, *ACS Energy Lett.* **2024**, *9*, 1682. <https://doi.org/10.1021/acseenergylett.4c00306>
  - 2) S. O. Furer, S. R. Marder, U. Bach, *et al.*, *ACS Appl. Energy Mater.* **2023**, *6*, 667. <https://doi.org/10.1021/acsaem.2c02735>
  - 3) Y. Hou, H. J. Snaith, C. J. Brabec, *et al.*, *Science* **2017**, *358*, 1192. <https://doi.org/10.1126/science.aao5561>
  - 4) J. Xie, X. Yu, M. Lei, D. Yang, *et al.*, *Adv. Sci.* **2017**, *4*, 1700018. <https://doi.org/10.1002/advs.201700018>

The PANDI is covered by a patent pending (US Patent Application No. 18/416,458) for which Kaunas University of Technology (KTU), Lithuania, and King Abdullah University of Science and Technology (KAUST), Saudi Arabia, are co-applicants. TCI has been granted the right to manufacture and sell this material.

# n-Type SAM Forming Agent Enabling Efficient Perovskite Solar Cell: PANDI

## Solution coating method of PANDI



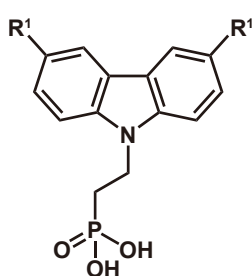
1. Dissolve PANDI [P3307] in chlorobenzene (0.5-1.0 mg/mL).
2. Spin-coat the solution onto ITO glass (5000 rpm, 30 seconds).
3. Anneal the substrate at 100°C for 10 minutes.
4. Wash the formed SAM layer with chlorobenzene.

### Reference

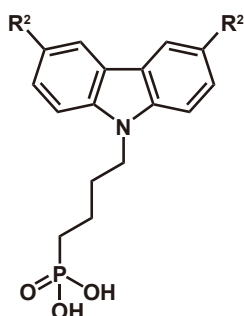
D. S. Utomo, L. M. Svirskaitė, A. Musiienko, V. Getautis, T. Malinauskas, R. Azmi, S. De Wolf, *et al.*, *ACS Energy Lett.* **2024**, *9*, 1682.

<https://doi.org/10.1021/acseenergylett.4c00306>

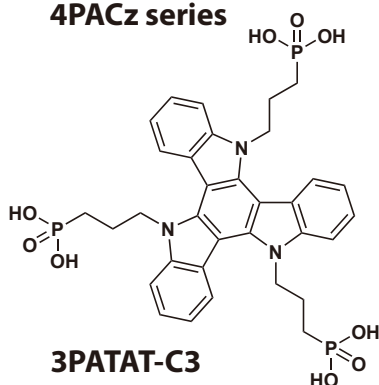
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<b>R<sup>1</sup>=MeO</b>	<b>MeO-2PACz</b>	500mg	<b>[D5798]</b>
<b>R<sup>1</sup>=Me</b>	<b>Me-2PACz</b>	500mg	<b>[M3477]</b>
<b>R<sup>1</sup>=Br</b>	<b>Br-2PACz</b>	500mg	<b>[B6391]</b>
<b>R<sup>1</sup>=Cl</b>	<b>Cl-2PACz</b>	500mg	<b>[C3914]</b>
<b>R<sup>1</sup>=F</b>	<b>F-2PACz</b>	500mg	<b>[F1374]</b>
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<b>R<sup>2</sup>=H</b>	<b>4PACz</b>	500mg	<b>[P2995]</b>
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<b>R<sup>2</sup>=Me</b>	<b>Me-4PACz</b>	500mg	<b>[M3359]</b>
<b>R<sup>2</sup>=Br</b>	<b>Br-4PACz</b>	500mg	<b>[B6445]</b>
	<b>3PATAT-C3</b>	500mg	<b>[P3172]</b>

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