

# **N-Bromosuccinimide as a P-type Dopant for Spiro-OMeTAD Hole Transport Material to Enhance Performance of Perovskite Solar Cells**

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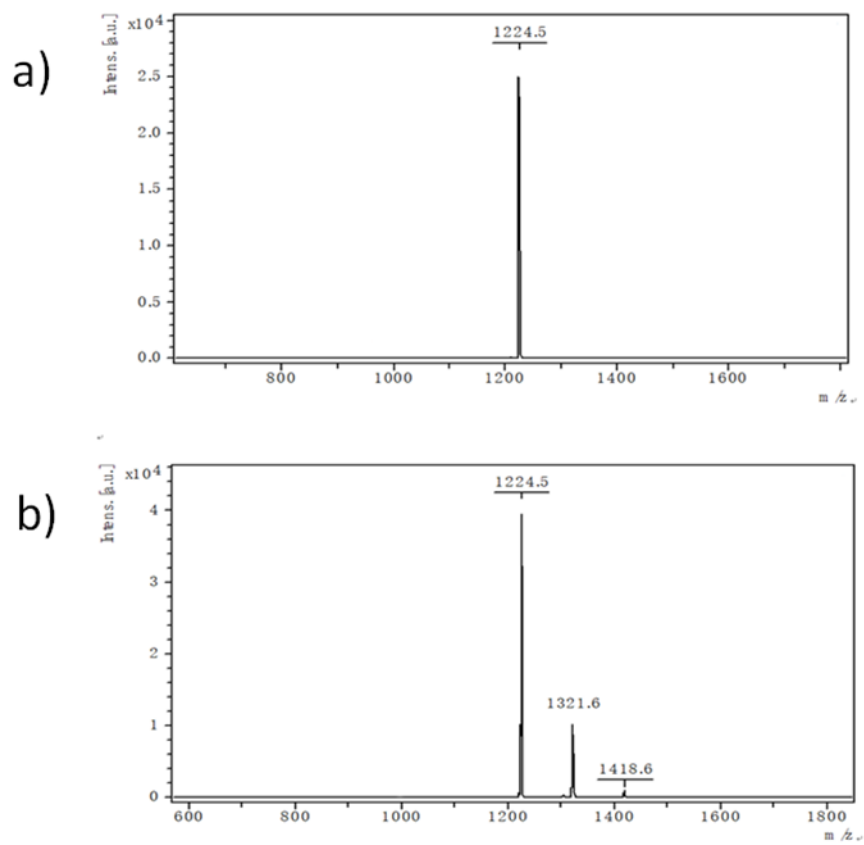
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**Figure S1** (a) The mass spectrometry (MS) of Spiro-OMeTAD and (b) Spiro-OMeTAD with NBS.

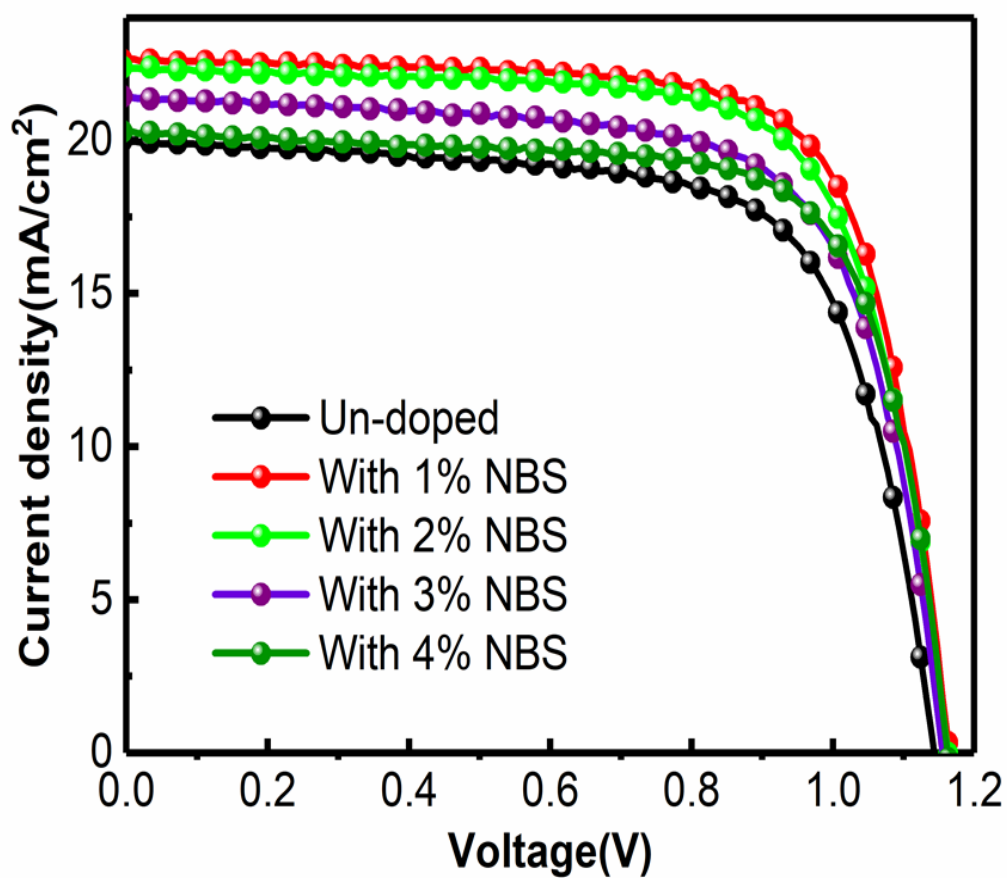
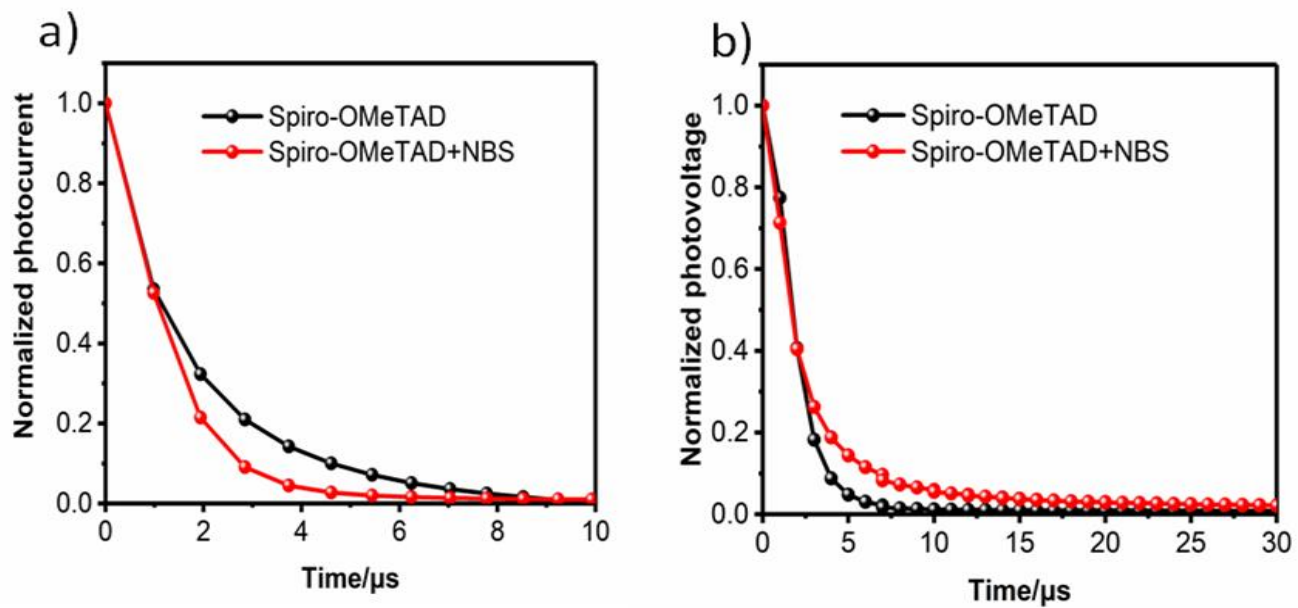


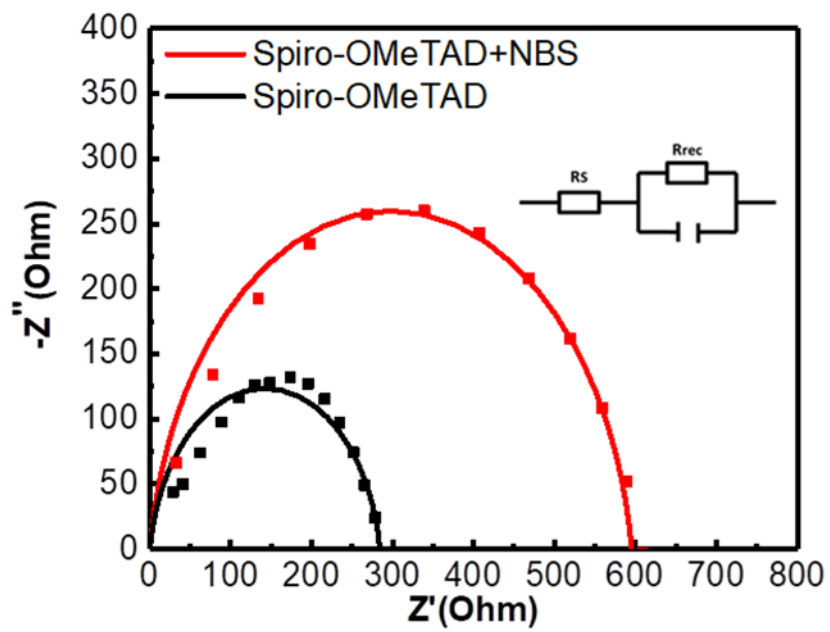
Figure S2 J-V curves of the devices with different concentration of NBS

Table S1 Photovoltaic characteristics statistics based on different Spiro-OMeTAD HTM.

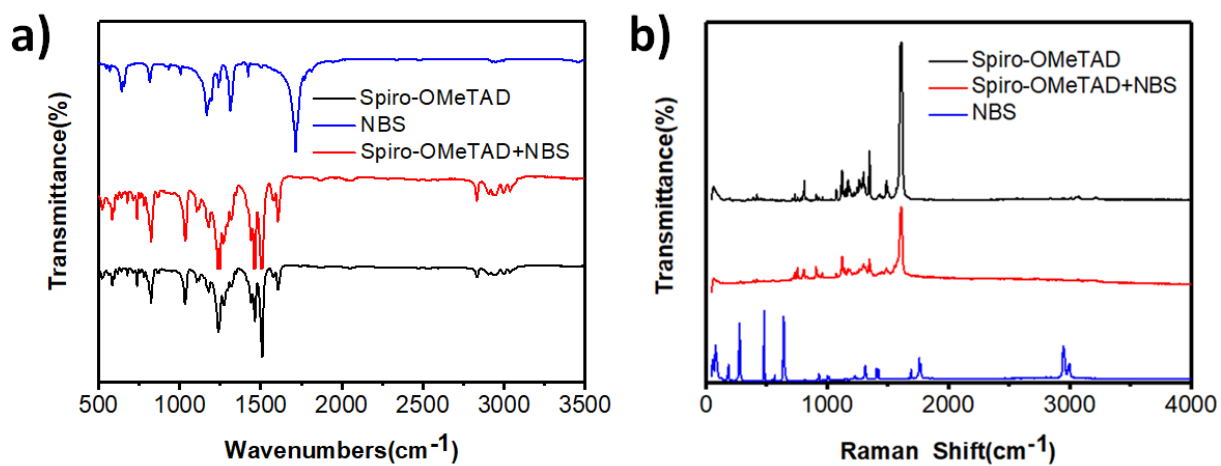
NBS concentration	$V_{OC}$ (V)	$J_{SC}$ (mA/cm <sup>2</sup> )	FF (%)	PCE (%)
0	1.14	20.02	69.58	16.12
1%	1.16	22.63	73.01	19.24
2%	1.16	22.35	71.69	18.63
3%	1.14	21.90	71.59	17.83
4%	1.14	20.28	70.68	16.54



**Figure S3** (a) Transient photocurrent (TPC) and (b) Transient photovoltage (TPV) of devices.



**Figure S4** Nyquist plots acquired from devices using Spiro-OMeTAD and Spiro-OMeTAD-NBS as HTM, respectively.



**Figure S5** (a) and (b) The FT-IR and Raman spectroscopy of NBS, Spiro-OMeTAD and Spiro-OMeTAD doped NBS.