

## Supporting Information

# Comparison of NiO<sub>x</sub> thin film deposited by spin-coating or thermal evaporation for application as a hole transport layer of perovskite solar cells

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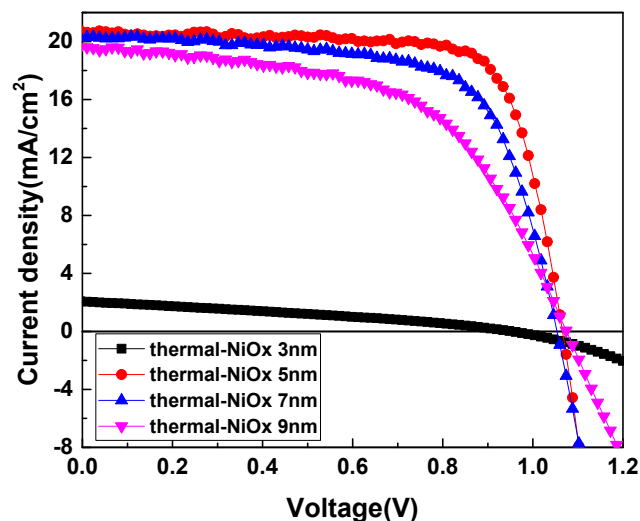
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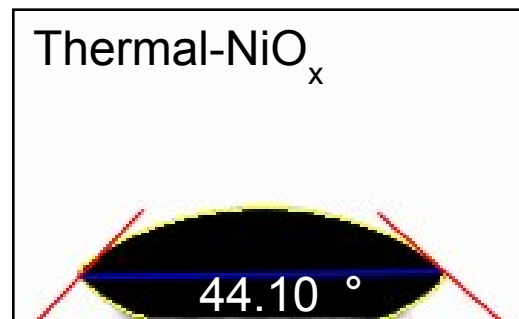
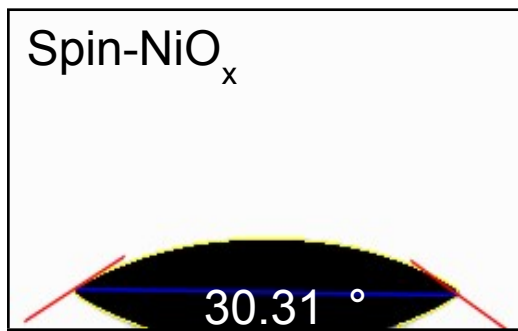
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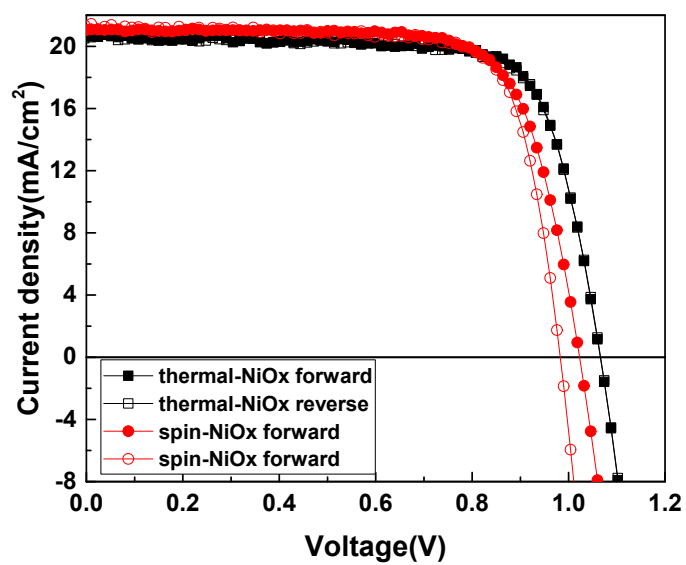
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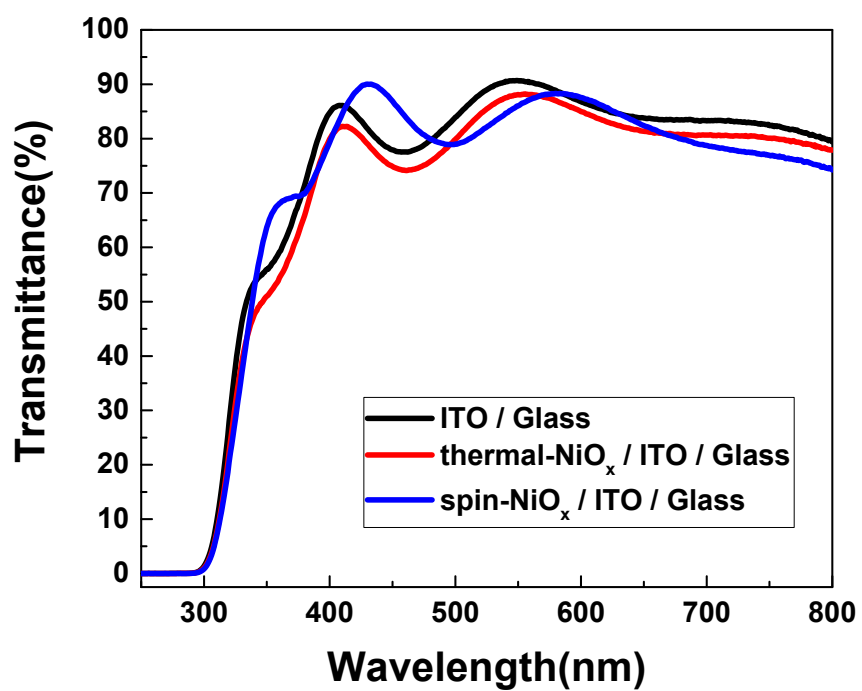
**Fig. S1** J-V curves of perovskite solar cells with thermal-NiO<sub>x</sub> according to the different thickness of thermal NiO<sub>x</sub>.



**Fig. S2** Contact angles of (a) the spin-NiO<sub>x</sub> and (b) the thermal-NiO<sub>x</sub> for perovskite precursor solution.



**Fig. S3** Forward and reverse J-V curves of the best performing PSCs with each of thermal-NiO<sub>x</sub> and spin-NiO<sub>x</sub>.



**Fig. S4** Optical transmission spectra of spin-NiO<sub>x</sub> or thermal-NiO<sub>x</sub> on ITO/Glass and ITO/Glass at 200~800nm wavelength.