Supplementary Information

Highly reproducible planar Sb$_2$S$_3$-sensitized solar cells based on atomic layer deposition

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**Fig. S1** Cross-sectional high-resolution SEM image of full cell with ALD 1600 layer: FTO/Bl-TiO$_2$/Sb$_2$S$_3$-ALD1600/P3HT/Au.

**Fig. S2** Photoluminescent (PL) quenching spectra of FTO/bl-TiO$_2$/Sb$_2$S$_3$-CBD/P3HT and FTO/bl-TiO$_2$/Sb$_2$S$_3$-ALD1600/P3HT sample (excitation = 650 nm-wavelength). The PL intensity of FTO/bl-TiO$_2$/Sb$_2$S$_3$-ALD1600/P3HT sample was more severely quenched than the FTO/bl-TiO$_2$/Sb$_2$S$_3$-CBD/P3HT sample. This might be attributed to the better charge injection from Sb$_2$S$_3$ into TiO$_2$ in ALD1600 sample because the pure Sb$_2$S$_3$ was formed by the ALD process and as a result, the traps might be significantly removed.
**Fig. S3** Transmittance spectra of Sb$_2$S$_3$-ALD1600 and Sb$_2$S$_3$-CBD. The transmittance of Sb$_2$S$_3$-CBD sample was higher than Sb$_2$S$_3$-ALD1600 sample. This might be attributed to the low absorption of Sb$_2$S$_3$-CBD because the impurities were formed by the CBD process.

**Fig. S4** (a) TEM-EDX of Sb$_2$S$_3$-ALD1600 and (b) Sb$_2$S$_3$-CBD. The Sb/S ratio of Sb$_2$S$_3$-ALD1600 was 0.77 (=43.73/56.27), but Sb$_2$S$_3$-CBD was near 1 (=49.34/50.66). Sb$_2$S$_3$-CBD sample have higher Sb/S ratio due to impurity.