Supplementary Information

Nanoimprinted Perovskite Nanograting Photodetector with Improved Efficiency

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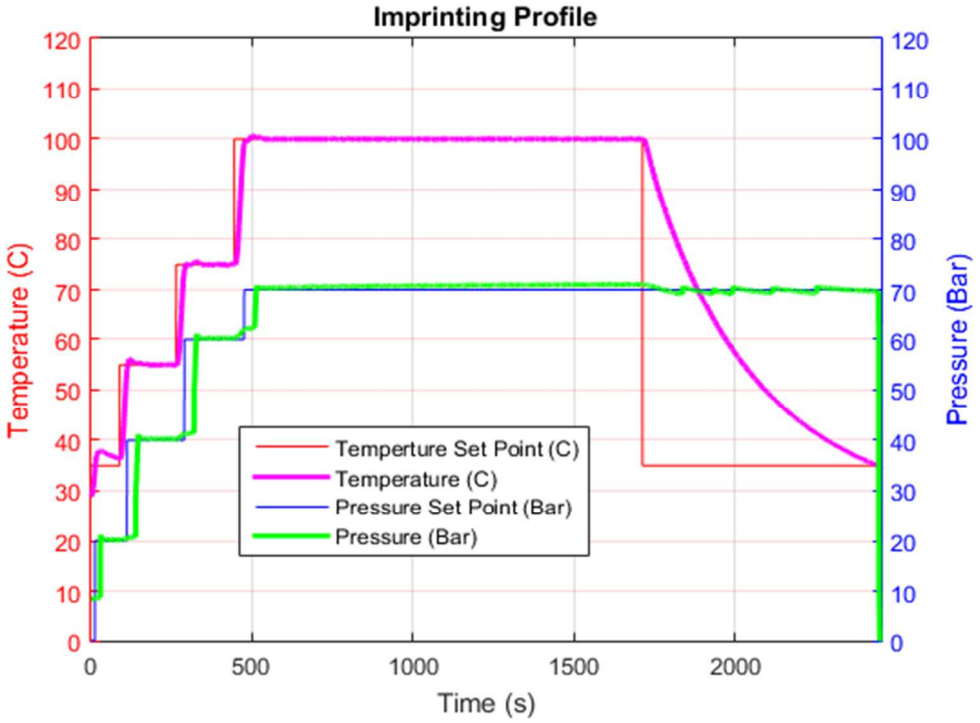

Figure S1: Temperature and pressure profile of the NIL process. The imprint was conducted at a temperature of 100 ^{o}C and a pressure of 70 Bar for 20 minutes.

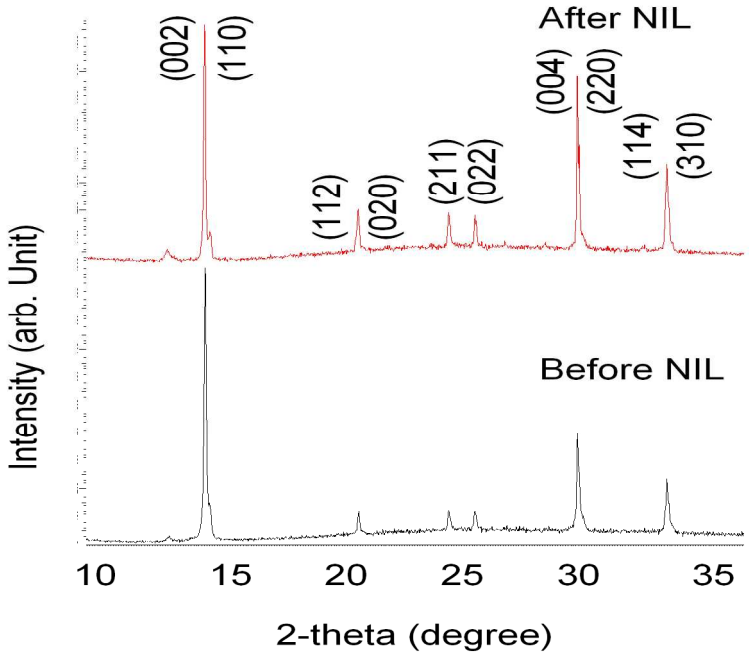

Figure S2: X-ray diffraction of $MAPbI_3$ non-imprinted film and nano-imprinted film using a nanograting mold over an area of 1 cm^2. The crystallinity of perovskite is clearly shown in the X-ray diffraction patterns.

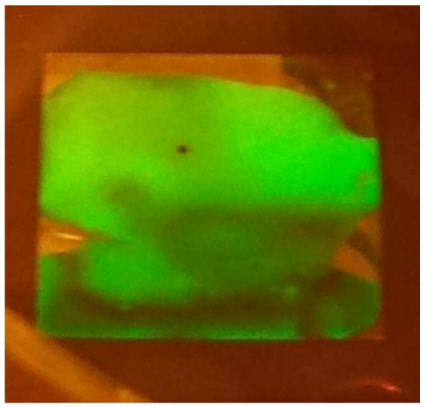

Figure S3: Optical image of the imprinted perovskite nanohole sample. The greenish iridescence is the structural color due to the photonic crystal effect of the nanohole structures. The dark area indicates defect area of nanoimprint.

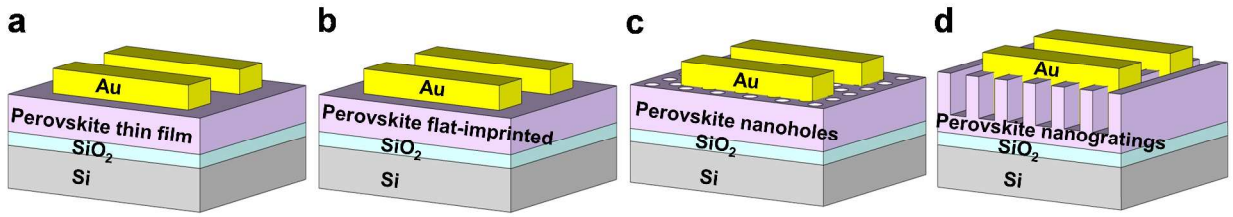

Figure S4: 3-D schematic of (a) tf-PSPD, (b) flat-PSPD, (c) nanohole-PSPD and (d) nanograting-PSPD.

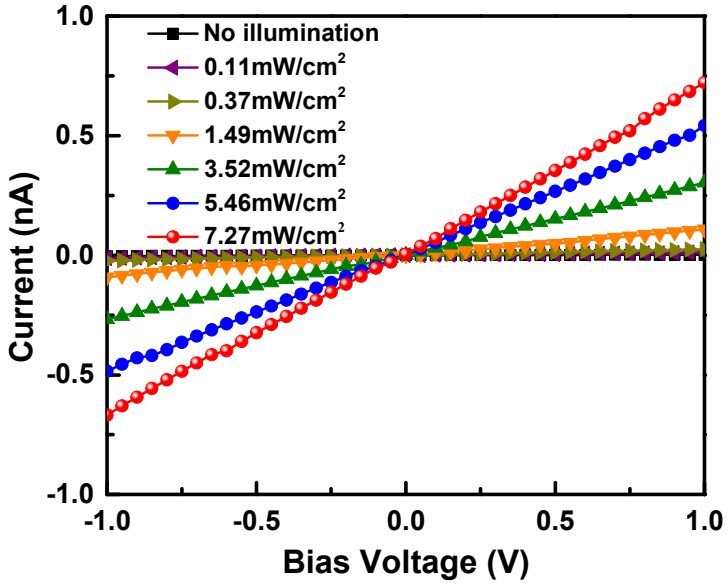

Figure S5: I-V characteristics of a tf-PSPD in dark environment and under 0.11 mW/cm^2 to 7.27 mW/cm^2 halogen light illumination.

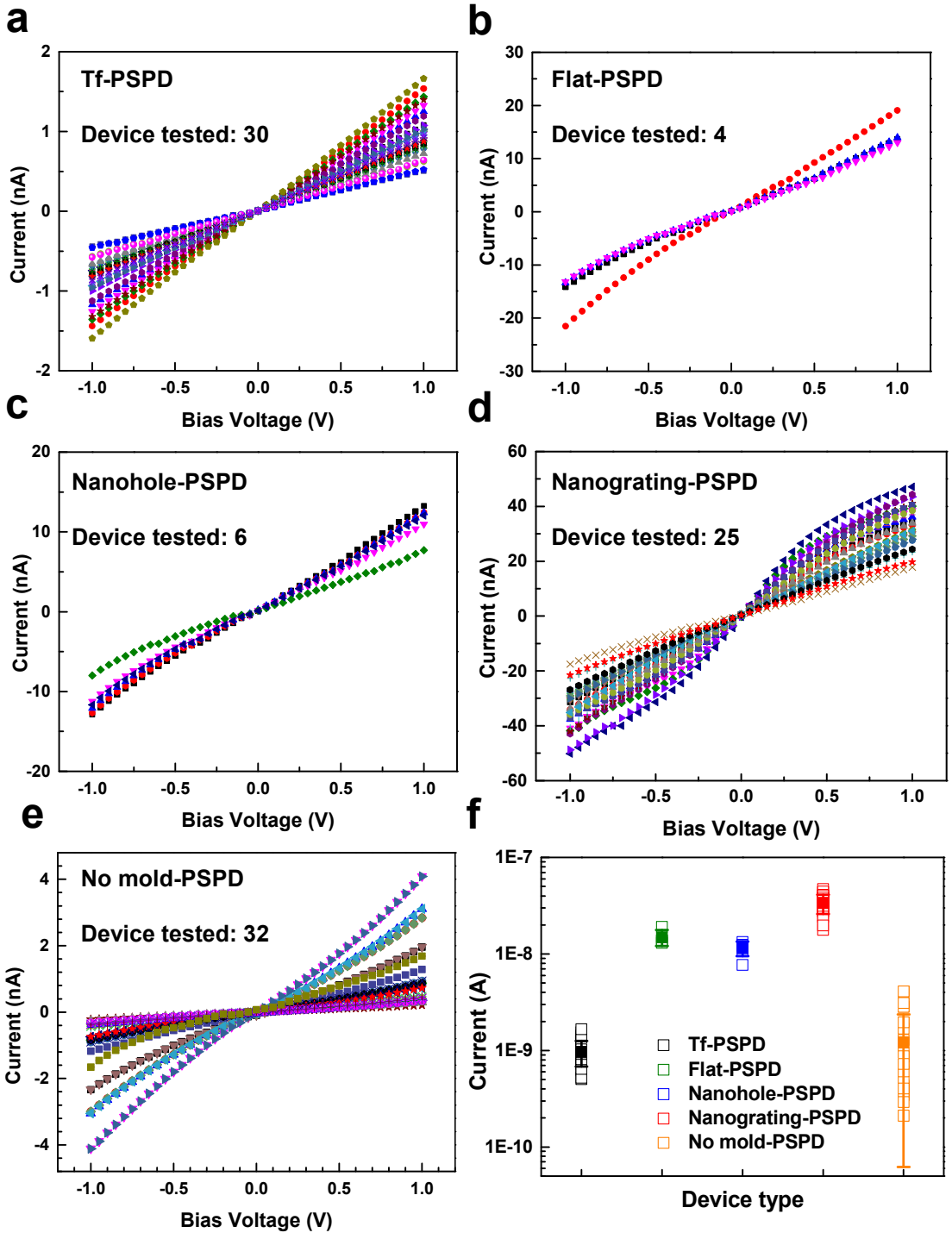

Figure S6: I-V characteristics of (a) tf-PSPDs, (b) flat-PSPDs, (c) nanohole-PSPDs, (d) nanograting-PSPDs and (e) no mold-PSPD under 7.27 mW/cm^2 halogen light illumination. Multiple devices are tested for each type. No mold-PSPD refers to devices formed on the area without Si molds for the same imprinted perovskite sample. (f) Current plot of all four types of

devices under 7.27 mW/cm^2 halogen light illumination with a bias voltage of 1V. The mean values with standard deviation are indicated in the plot for each type.

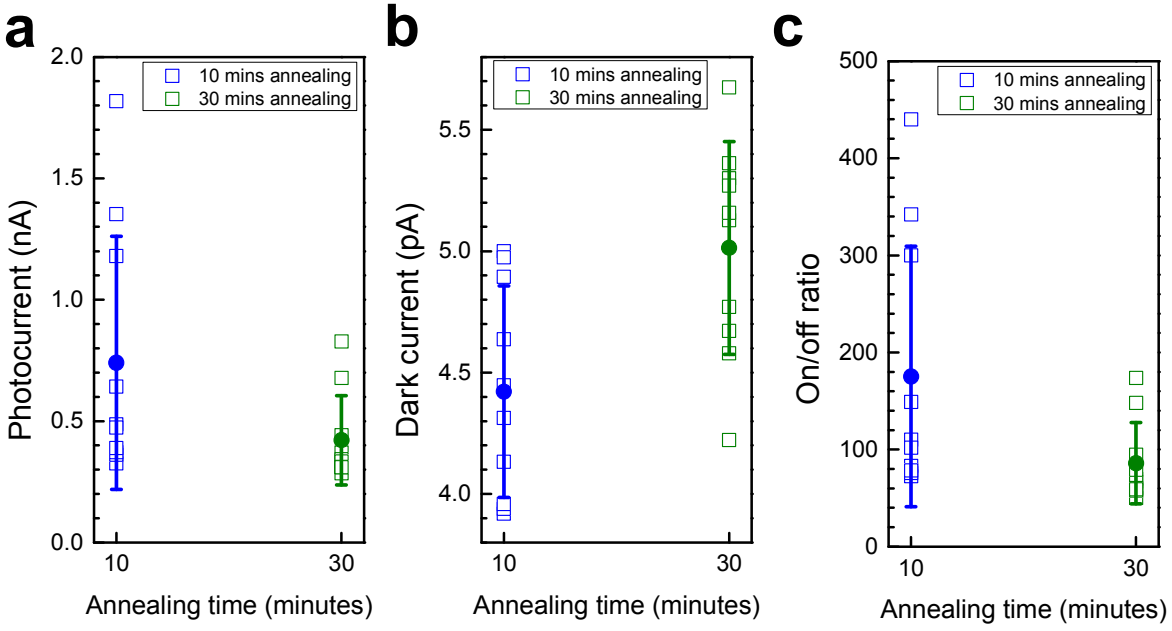

Figure S7: Performance comparison between tf-PSPDs with 10 minutes thermal annealing and 30 minutes thermal annealing of (a) photocurrent under 7.27 mW/cm^2 halogen light illumination, (b) dark current and (c) on/off ratio. The thermal annealing was done at a temperature of 100 ^{o}C during perovskite thin-film preparation process. 10 devices were tested for each condition with a bias voltage of 1 V.

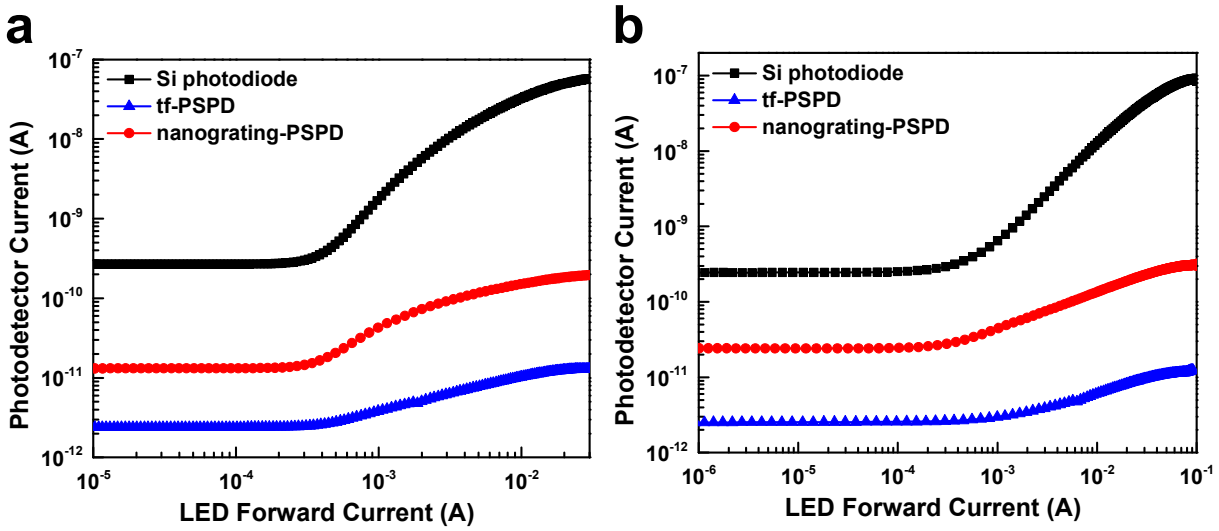

Figure S8: Plot of photodetector current vs LED forward current at (a) λ=466 nm and (b) λ=635 nm. The tf-PSPD and nanograting-PSPD were both biased at 1 V and the Si photodiode was

reverse biased at 10 V. The Si photodiode has an effective radiation sensitive area of 2.84 mm × 2.84 mm and was used to calibrate the irradiance.

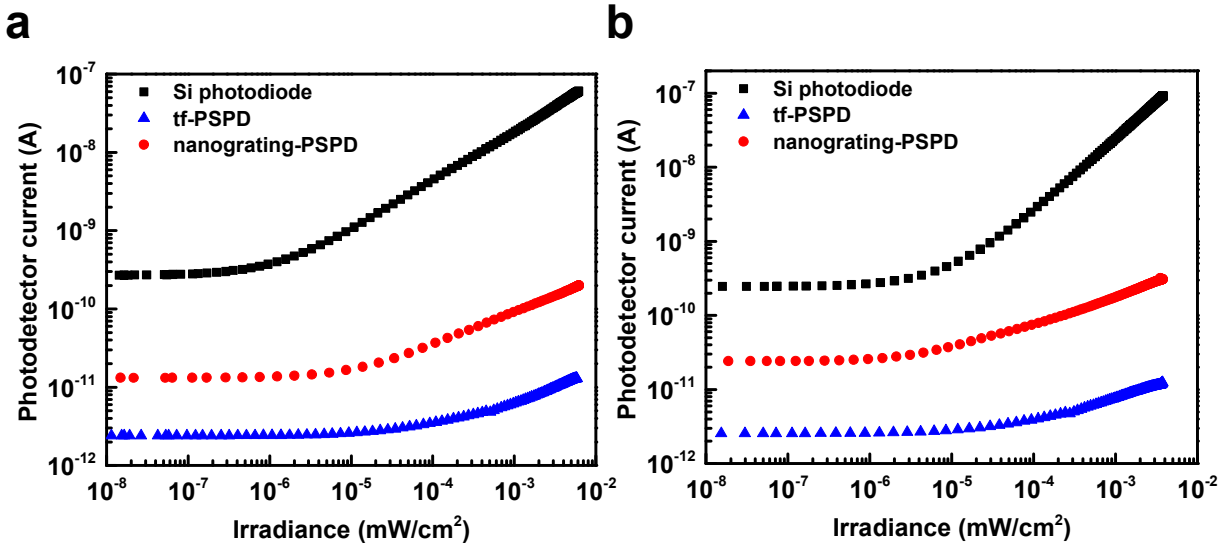

Figure S9: Plot of photodetector current vs irradiance at (a) λ=466 nm and (b) λ=635 nm. The irradiance was evaluated with the Si photodiode, which has a responsivity of 0.12 A/W at λ=466 nm and 0.3 A/W at λ=635 nm. The lowest irradiance was chosen to be the three sigma value of the Si photodetector dark current distribution.

Table S1: Complete performance of tf-PSPDs, flat-PSPDs, nanohole-PSPDs and nanograting-PSPDs under 7.27 mW/cm^2 halogen light illumination.

Device structure	Photo current (nA)	On/off ratio (kilo)	Responsivity (mA/W)
Tf-PSPD (30 devices)	0.97±0.28	0.425±0.079	5.33±1.54
Flat-PSPD (4 devices)	14.9±2.81	2.20±0.25	82.1±15.5
Nanohole-PSPD (6 devices)	11.5±1.99	2.12±0.45	63.1±10.9
Nanograting-PSPD (25 devices)	33.6±7.6	2.92±0.21	185±41.8