Electronic Supplementary Material (ESI) for RSC Advances.

Artificial inverted compound eye structured polymer films with light-harvesting and self-cleaning functions for encapsulated III-V solar cell applications

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Supplementary Information

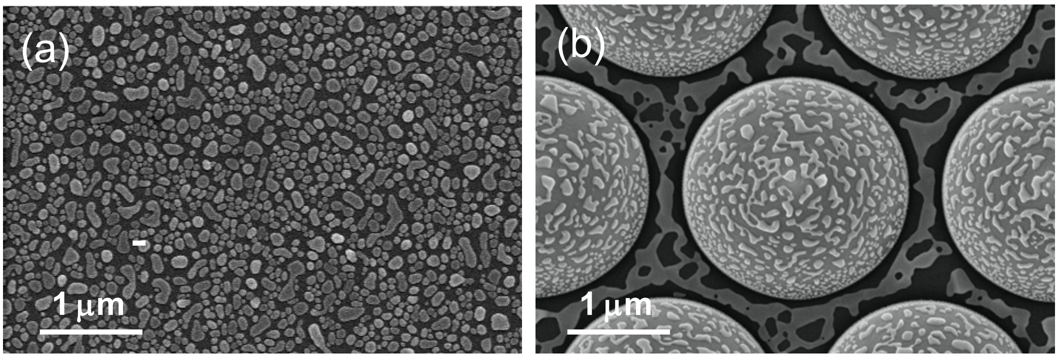

Fig. S1 FE-SEM images of the thermally dewetted Au nanopatterns on the surface of (a) flat sapphire and (b) p-MGs/sapphire.

Fig. S1 shows the FE-SEM images of the thermally dewetted Au nanopatterns on the surface of (a) the flat sapphire and (b) the p-MGs/sapphire. For the flat sapphire, the dot-like Au nanopatterns were formed with small average period of ~ 100±20 nm and high average density of ~ 70%, respectively. The period and density of metal nanopatterns, which influence the transmission or reflection properties, were strongly dependent on the thickness of metal thin film.[1,2] In general, when the period is lower than ~ 200 nm and the density is larger than ~ 70%, the high transmission (or low reflection) can be obtained at UV, visible, and near-infrared (NIR) wavelengths.[3-7] However, the Au nanopatterns on the p-MGs/sapphire were not only partially interlinked, but also formed with different densities between flat and grating surfaces. This may be attributed to the different surface geometries.[8] For the flat sapphire, the heat arrives uniformly on the Au thin film due to the flat surface, and thus it can be agglomerated into the dot-like nanoparticles. However, the Au thin film on the p-MGs/flat sapphire is changed into partly interlinked nanopatterns because of the disturbance of heat transfer on the flat area caused by the MGs and the MG geometry with an inclination though the heat is applied. Nevertheless, the NTs were well formed on the p-MGs/sapphire using the partially interlinked Au nanopatterns, resulting in the CESs on the sapphire substrate as a master mold, as shown in Fig. 2(a).

Fig. S2 Optical measurement systems using an integrating sphere for (a) the total transmittance, (b) the diffuse transmittance, and (c) the total reflectance.

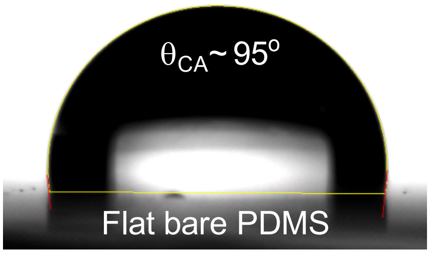

Fig. S3 Photograph of a water droplet on the surface of the flat bare PDMS film.

Fig. S4 Schematic diagram for the water droplet cleaning concept on (a) bare coverglass and (b) the ICESs PDMS film.

Fig. S4 shows the schematic diagram for the water droplet cleaning concept on (a) the bare coverglass and (b) the ICESs PDMS film. The dust particles or other contaminants on the coverglass with a hydrophilic surface (i.e., θ_{CA}~ 32°) are merely rearranged by the flowed water droplets and thus remained on the surface. On the contrary, the particles on the hydrophobic surface of the ICESs PDMS film with a high θ_{CA} of ~ 121° can be removed by the rolling down water droplets, which is called by a self-cleaning.[9] The supplementary Video clip shows the water droplet cleaning behaviors of bare coverglass (small screen) and the ICESs PDMS film (large screen) with black charcoal particles on each surface. After dropping of water droplets, the black charcoal particles on the bare coverglass are partially remaining with water at the edges. However, the black charcoal particles on the ICESs PDMS film are clearly washed by the rolling down water droplets.

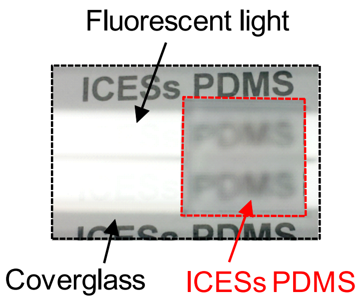

Fig. S5 Photograph of the ICESs PDMS film (red dotted line) laminated on the coverglass (black dotted line).

Supplementary Information References

1 J. M. Lee and B. I. Kim, *Mater. Sci. Eng. A*, 2007, **449-451**, 769.

2 G. C. Park, Y. M. Song, J. H. Ha and Y. T. Lee, *J. Nanosci. Nanotechnol.*, 2011, **11**, 6152.

3 J. W. Leem and J. S. Yu, *Opt. Express*, 2012, **20**, 26160.

4 J. W. Leem, Y. Yeh and J. S. Yu, *Opt. Express*, 2012, **20**, 4056.

5 Y. M. Song, Y. Jeong, C. I. Yeo and Y. T. Lee, *Opt. Express*, 2012, **20**, A916.

6 J. W. Leem and J. S. Yu, *Opt. Express*, 2012, **20**, A431.

7 J. W. Leem, Y. P. Kim and J. S. Yu, *J. Opt. Soc. Am. B*, 2012, **29**, 357.

8 J. W. Leem, Y. M. Song and J. S. Yu, *Nanoscale*, 2013, **5**, 10455.

9 J. W. Leem, S. Kim, S. H. Lee, J. A. Rogers, E. Kim and J. S. Yu, *Adv. Energy Mater.*, 2014, **4**, 1301315.