Supporting Information for

"Self-cleaning effect of highly water-repellent microshell structures for solar cell application"

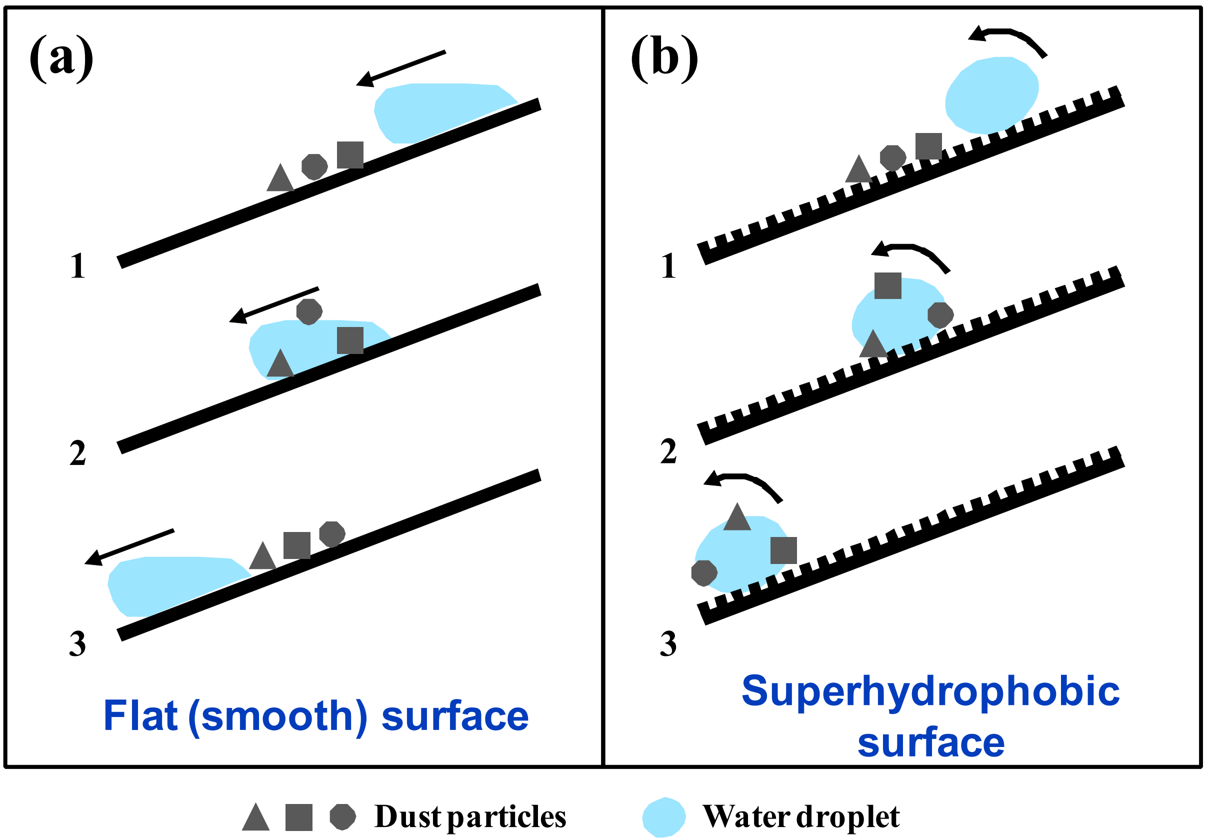


Figure S1. Cleaning concept in (a) flat surface and (b) superhydrophobic surface

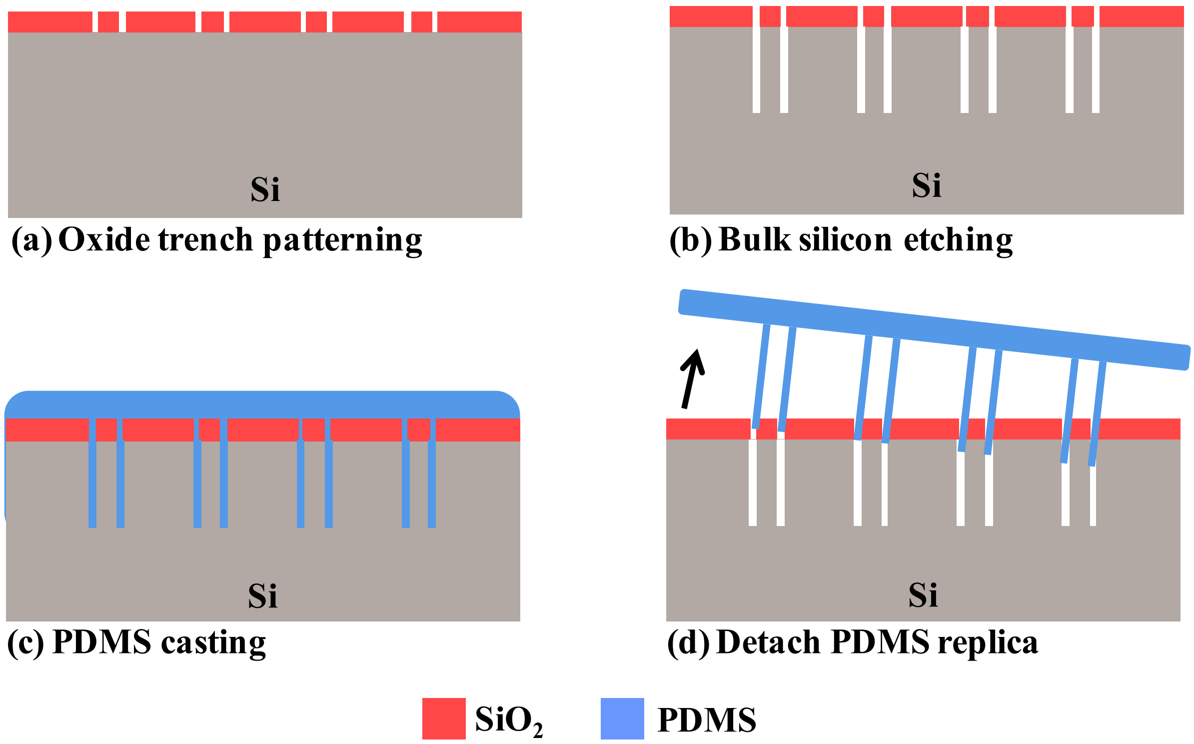


Figure S2. Fabrication process microshell PDMS. (a) Formation of oxide trench pattern, (b) bulk silicon etching to form silicon trench pattern, (c) casting of PDMS solution on silicon trench, and (d) detachment of replicated microshell PDMS after curing.

Formation of anti-adhesion layer:

The purpose of anti-adhesion layer is to reduce the adhesion force between the silicon trench and the PDMS replica layer. In order to achieve this, self-assembled monolayers (SAM), which can act as an anti-adhesion layer, were formed on a silicon trench substrate with a silanizing agent (tridecafluoro-1,1,2,2-tetrahydrooctyl trichlorosilane, CF_3-$(CF_2)_5(CH_2)_2$-$SiCl_3$, Fluka) via a vapor deposition method inside the desiccator. This SAM layer helped in releasing the replicated PDMS by reducing the adhesion between the silicon trench substrate and the PDMS replica.

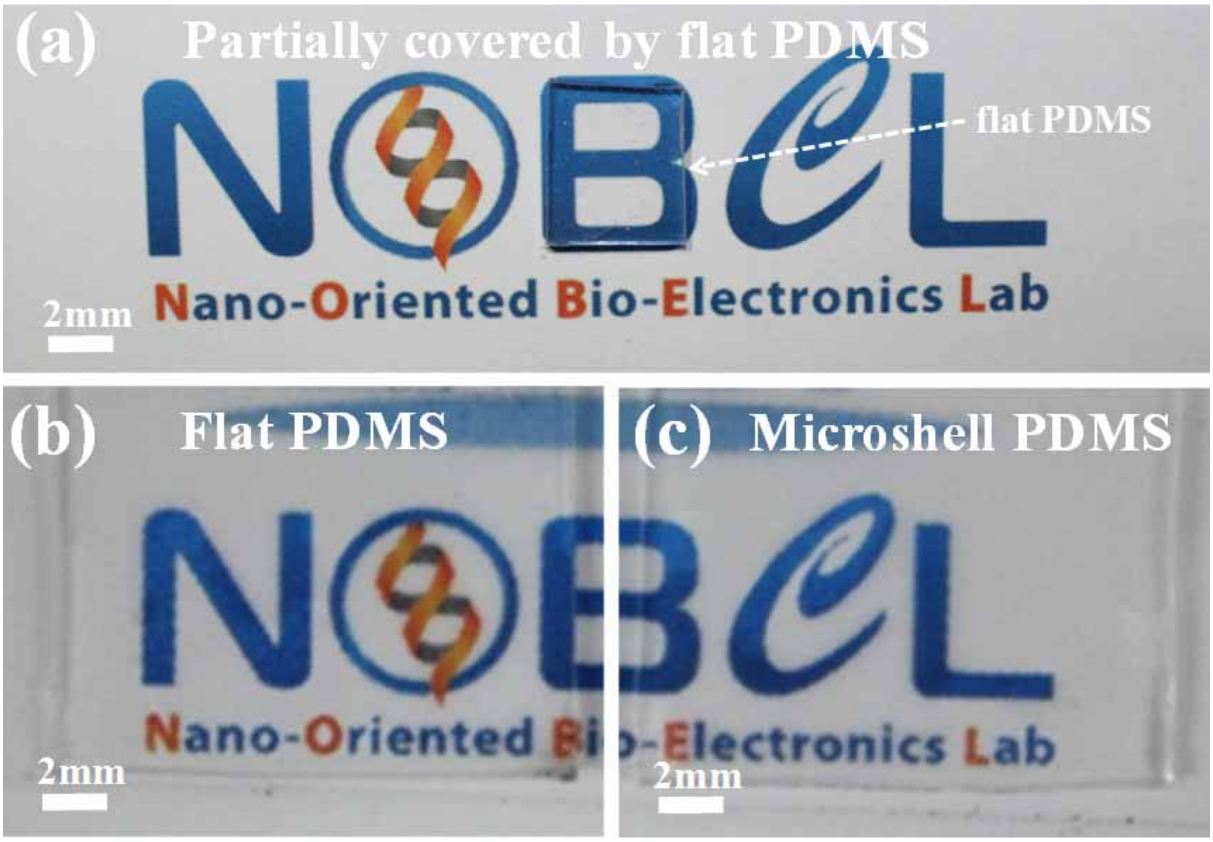
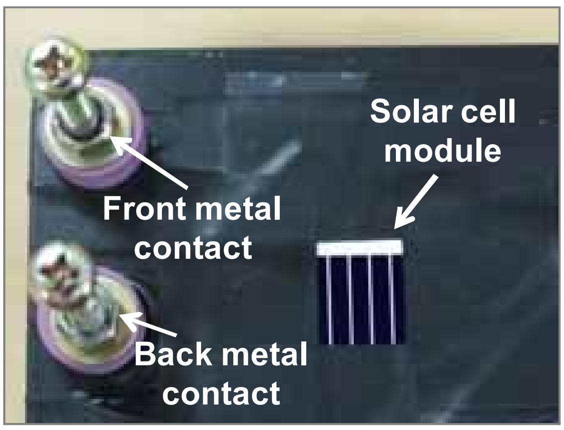


Figure S3. A photograph visually showing the transparency of (a) PDMS itself and the comparison of transparency of (b) flat PDMS and (c) microshell PDMS when placed on top of the laboratory logos.

(a)



(b)

Specification of solar cell

- Type: *Mono crystalline silicon*
- Thickness (Si): *200−m ±20−m*
- Front metal line: *2mm silver*
- Back metal line: *4mm silver*
- Anti-reflection coating: SiN_x
- Active area definition: *0.93* cm^2

Figure S4. (a) Photograph of commercial solar cell module with indication of metal lines. (b) Specification of solar cell used in this experiment.

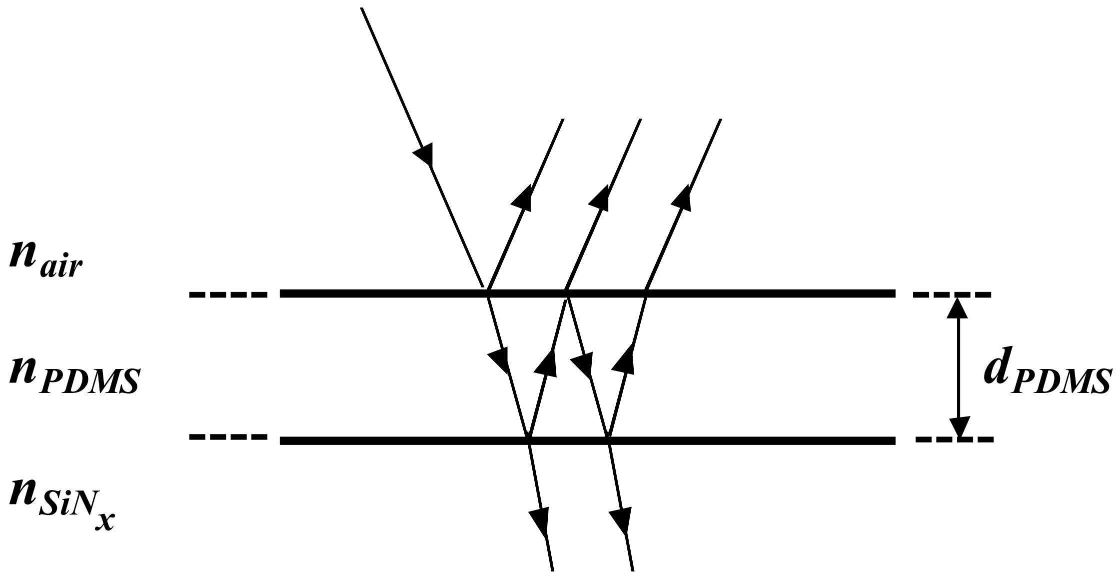


Figure S5. Schematic of incident light in air transmitting or reflecting as it travels through PDMS layer to the anti-reflection coating (SiN_x) of solar cell.

Calculation of reflection coefficient:

Solar cell module has an anti-reflection coating as the final layer of the module. This anti-reflection coating enhances the absorption of light on the silicon surface. Reflectance in Fresnel equation as given in Equation S1 is considered in order to minimize the reflection, where R_{min} is the minimum reflection coefficient. Therefore, refractive index matching must be met if PDMS layer is to be used for the final layer of solar cell panel while not degrading the efficiency. Refractive index of air, PDMS, and SiN_x are known as n_{air}=1, n_{PDMS}=1.4, and n_{SiNx}=1.9, respectively. PDMS as an intermediate layer is suitable for minimizing reflection loss. Ideally there is no reflection when refractive index of intermediate layer is 1.38.

$$R_{\min} = \left(\frac{n_{PDMS}{}^2 - n_{air} \cdot n_{SiNx}}{n_{PDMS}{}^2 + n_{air} \cdot n_{SiNx}} \right)^2 \text{ where } n_{PDMS} d_{PDMS} = \lambda_0 / 4 \quad \text{(S1)}$$