Supplementary information

Optical and electrical effects of nanobump structure combined with an undulated active layer on plasmonic organic solar cells

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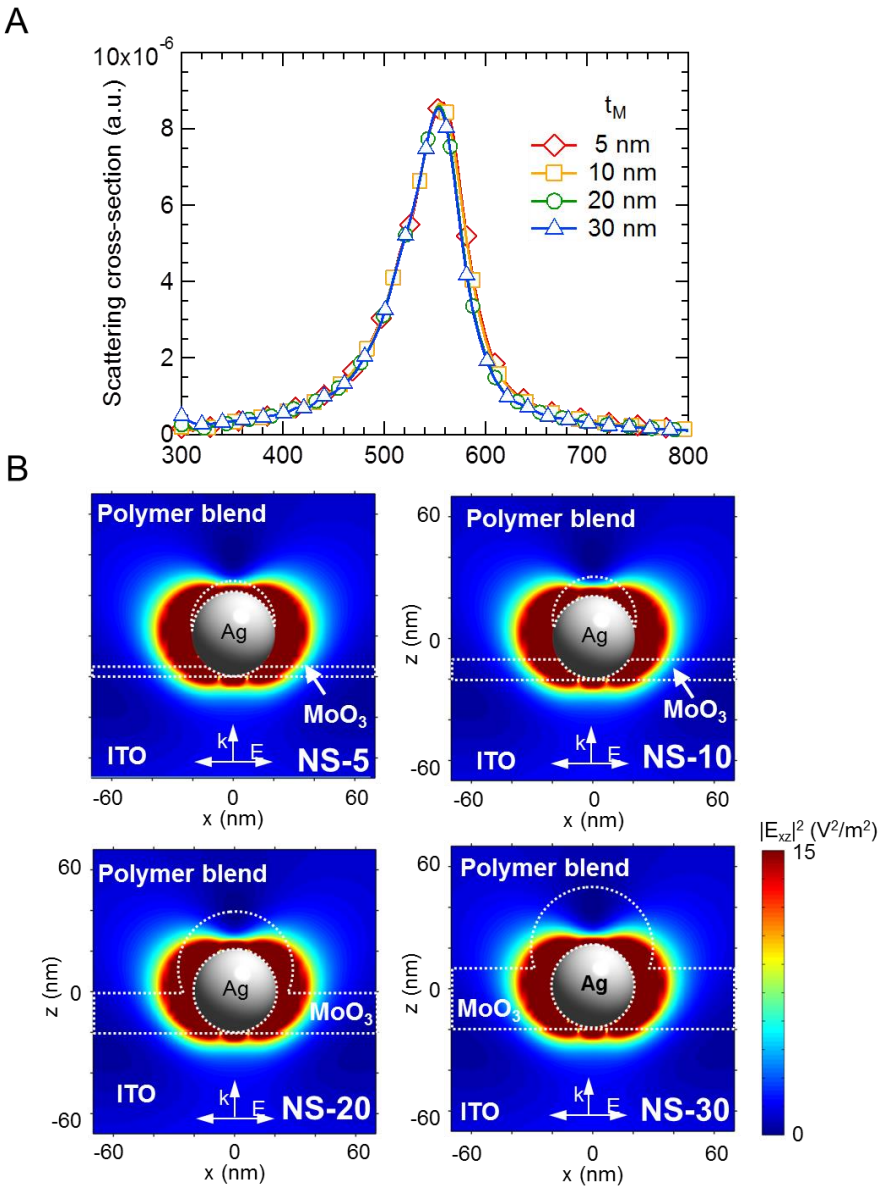

Fig. S1 (a) Scattering cross-section and (b) electric field distribution (λ = 550 nm, xz plane) of films including NS with different t_M using finite-difference time domain simulation. Here, the absorption coefficient (*k*) of all layer is fixed 0 to remove the side effect arising from the variation NS′s volume due to different t_M.

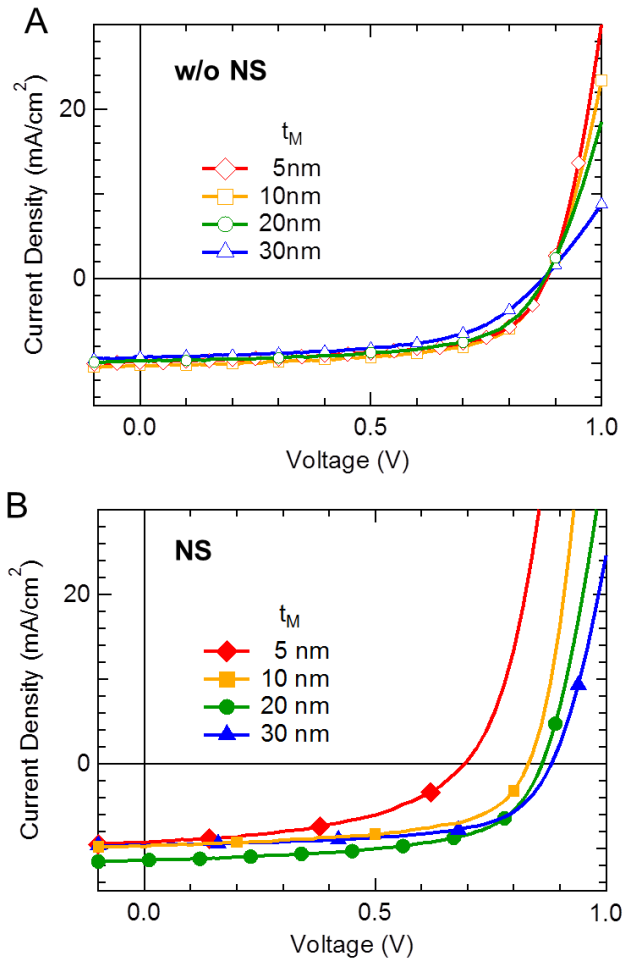

Fig. S2 J-V characteristics of OSCs (a) without and (b) with NS under illumination conditions.

The Fig. S2 shows J-V characteristics of device with and without NS depending on t_M. The current density at a forward bias (1 V) is inversely proportional to the t_M, which can be understood by the increased ohmic losses as the MoO_3 layer decreases. Meanwhile, it should be noted that the current density increases by inserting the NPs into devices. Additionally, the current density of device with NS-30 is similar to the case incorporating flat-10. These results reveal that increased surface area and insertion of NPs in OSC with NS improve carrier transport by reducing resistance. Therefore, it is apparent that the ohmic losses in the device with NS are improved compared to the device without NS.

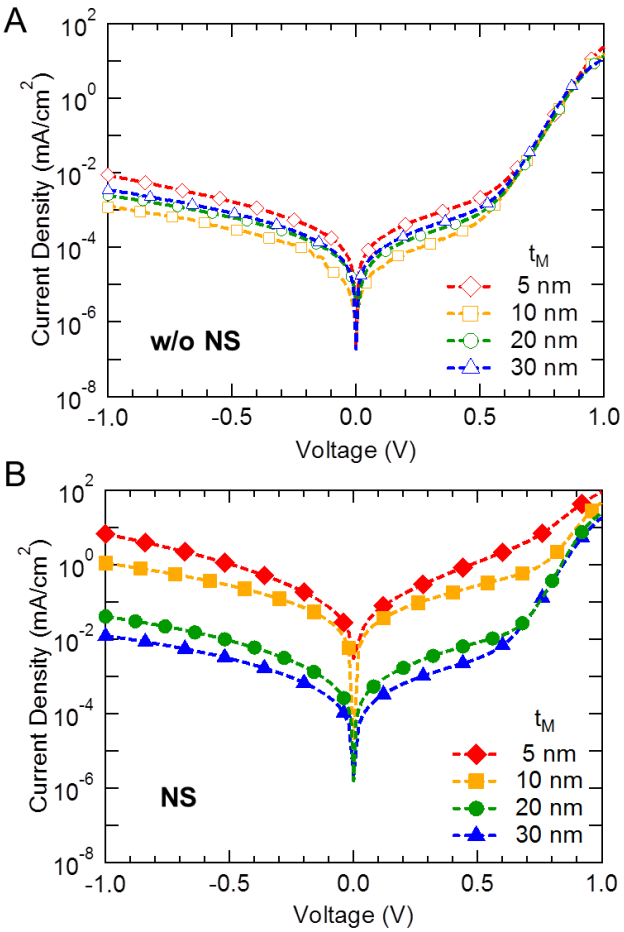

Fig S3. Semi log J-V characteristics of OSCs (a) without and (b) with NS

The Fig. S3 illustrates semi log J-V characteristics of device with and without NS employing different t_M. In the cases of OSC without NS, the current densities at reverse bias (-1 V) are similar among devices, which are independent on t_M. In contrast, the current density increases in the device with thin t_M (NS-5 and 10). Particularly, these values of NS-5 and 10 cases are two-orders of magnitude higher than those of NS-20 and 30. These results reveal that leakage losses increase in the device with partially covered NPs.

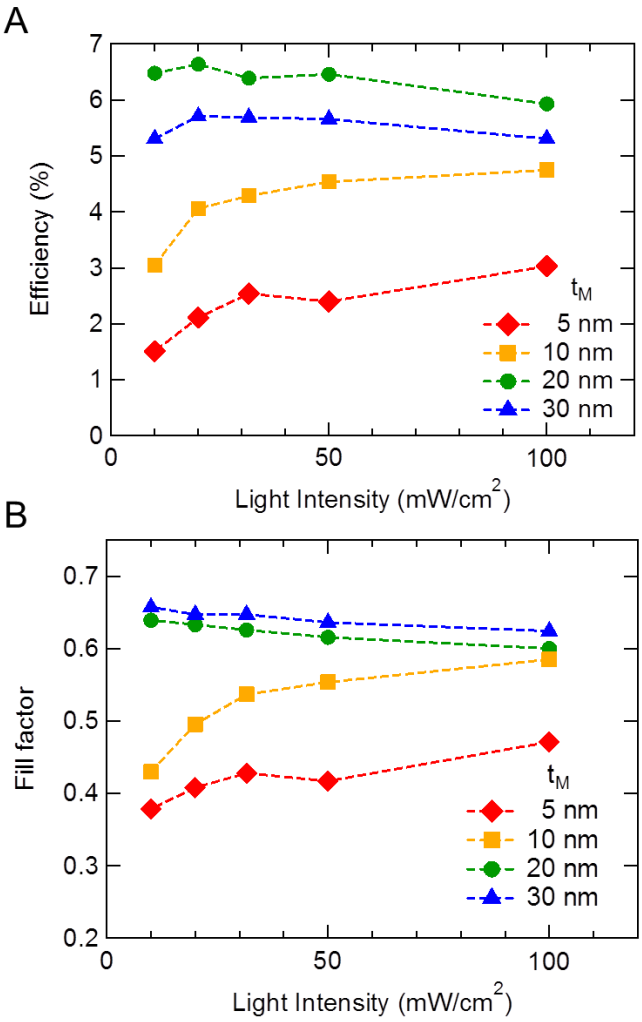

Fig S4. (a) Efficiency and (b) fill factor of OSC with NS as a function of incident light intensity. The abrupt reduction of device performance at a lower light intensity (≤ 20mW/cm^2) is observed in NS-5 and 10, while devices with NS-20 and 30 show similar performance as the case under higher light illumination.