Surface Potential Measurement at MoS_2/g-C_3N_4 Heterojunction under Light Illumination

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Heterojunction photocatalysts have attracted considerable attention due to their excellent charge separation capabilities and excellent photocatalytic performance. However, most previous studies on heterojunction photocatalysts have relied on macroscopic characterization techniques with bulk (powder) samples, leaving the spatiotemporal dynamics of interfacial charge carriers largely unexplored. In this study, we prepared a heterojunction film sample of molybdenum disulfide (MoS_2) and graphitic carbon nitride (g-C_3N_4), which is a combination of two-dimensional layered photocatalysts. The photo-induced surface potential at MoS_2/g-C_3N_4 heterojunction was investigated by Kelvin probe force microscopy (KPFM), where the electrostatic interaction between the sample and the conductive tip was extracted from the phase signal of the cantilever with a lock-in amplifier.

The MoS_2/g-C_3N_4 heterojunction sample was fabricated by transferring exfoliated MoS_2 nanosheets onto a g-C_3N_4 thin film deposited with thermal chemical vapor deposition [1]. Upon ultraviolet (UV) illumination with wavelength of 300–400 nm under ambient condition, a surface potential (SP) decrease of 10 mV on the MoS_2 side and an increase of 40 mV on the g-C_3N_4 side were observed as shown in Fig. 1(a)~(c), indicating photo-induced charge separation across the MoS_2/g-C_3N_4 interface. Then, the temporal variation of SP following the turning off the UV illumination was monitored as shown in Fig. 1(d). The extracted SP decay time constants were 140 s for MoS_2 and 3100 s for g-C_3N_4 near the heterojunction, both of which are much larger than those observed in the reference single-component samples (~30 s for MoS_2 and ~1000 s for g-C_3N_4). These results suggest that the MoS_2/g-C_3N_4 heterojunction promotes photo-induced charge separation and suppresses their recombination.

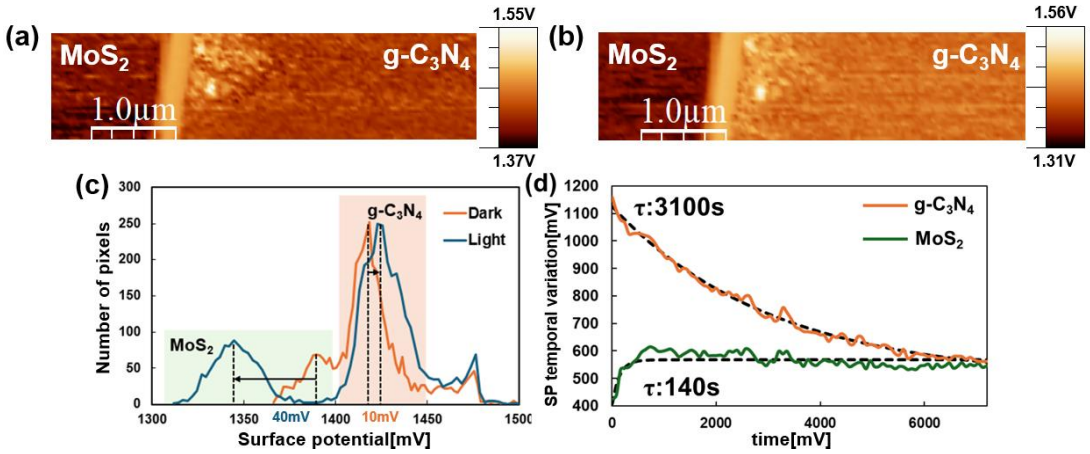

Figure 1. (a) Surface potential image under a dark condition. (b) Surface potential image under UV illumination at 80 s after turning on the illumination. (c) Histograms of surface potential values obtained from images (a) and (b). (d)Time-dependent surface potential variation on MoS_2 and g-C_3N_4 sides of the MoS_2/g-C_3N_4 heterojunction after turning off the UV illumination at $t = 0$.

Reference

[1] K. Ito, Sho Yoneyama, Shu. Yoneyama, P. Fons, K. Noda, ACS Mater. Au **5,** 299 (2025).