Supporting Information

Enabling Colloidal Synthesis of Edge-Oriented MoS_2 with Expanded Interlayer Spacing for Enhanced HER Catalysis

Yugang Sun,[†*] Farbod Alimohammadi,[†] Dongtang Zhang[†,‡] and Guangsheng Guo[‡]

[†]Department of Chemistry, Temple University, 1901 North 13th Street, Philadelphia, Pennsylvania 19122, USA

[‡]Beijing Key Laboratory for Green Catalysis and Separation, Department of Chemistry and Chemical Engineering, Beijing University of Technology, Beijing, 100124, P. R. China

Statistical Analysis of MoS_2 Nanosheets in the MoS_2/rGO Composite Samples

The SEM images of the MoS_2/rGO composite samples are used to estimate the density (i.e., number of MoS_2 nanosheets per unit of area) and projected edge length of the MoS_2 nanosheets anchored on the rGO nanosheets. Because the MoS_2 nanosheets protrude out of the basal surface of the rGO nanosheets, the edges of the MoS_2 nanosheets exhibit much brighter imaging contrast compared to the underneath rGO nanosheets. The stark imaging contrast enables us to count the number of MoS_2 nanosheets in the defined interesting regions. We first draw a square of 1 μm × 1 μm over a SEM image and count the number of bright lines (corresponding to MoS_2 nanosheets), resulting in the density of MoS_2 nanosheets (in a unit of sheets/μm^{-2}). Five squares are drawn and the corresponding densities are averaged and plotted in Figure 2D.

Because of the mechanical flexibility and somehow random orientations of individual MoS_2 nanosheets, it is unrealistically difficult to precisely measure either surface areas or edge lengths of the as-grown MoS_2 nanosheets. Since there is no specific structural relationship between the MoS_2 nanosheets and the supporting rGO nanosheets (i.e., no epitaxial relationship between MoS_2 and rGO), it is reasonably considered that the growth of the MoS_2 nanosheets is isotropic. Therefore, the overall length of the peripheral edges of each MoS_2 nanosheet is proportional to its projected edge length in the SEM image. For example, a MoS_2 nanosheet grows from one nucleation site and expands to a half circle with a radius of r through isotropic growth. The overall peripheral edge length is $2r+\pi r$ while the projected length is $2r$. The ratio between the projected edge length and the overall edge length is $2/(2+\pi)$, which is a constant independent of size of the nanosheet, indicating the proportional relationship between the projected edge length and the overall peripheral edge length. It is reasonable to use the projected edge length to study the relationship of catalytic performance on the overall peripheral edge length of the MoS_2 nanosheets. The averaged projected edge lengths of the MoS_2 nanosheets synthesized at the different temperatures are presented in Figure 2D.

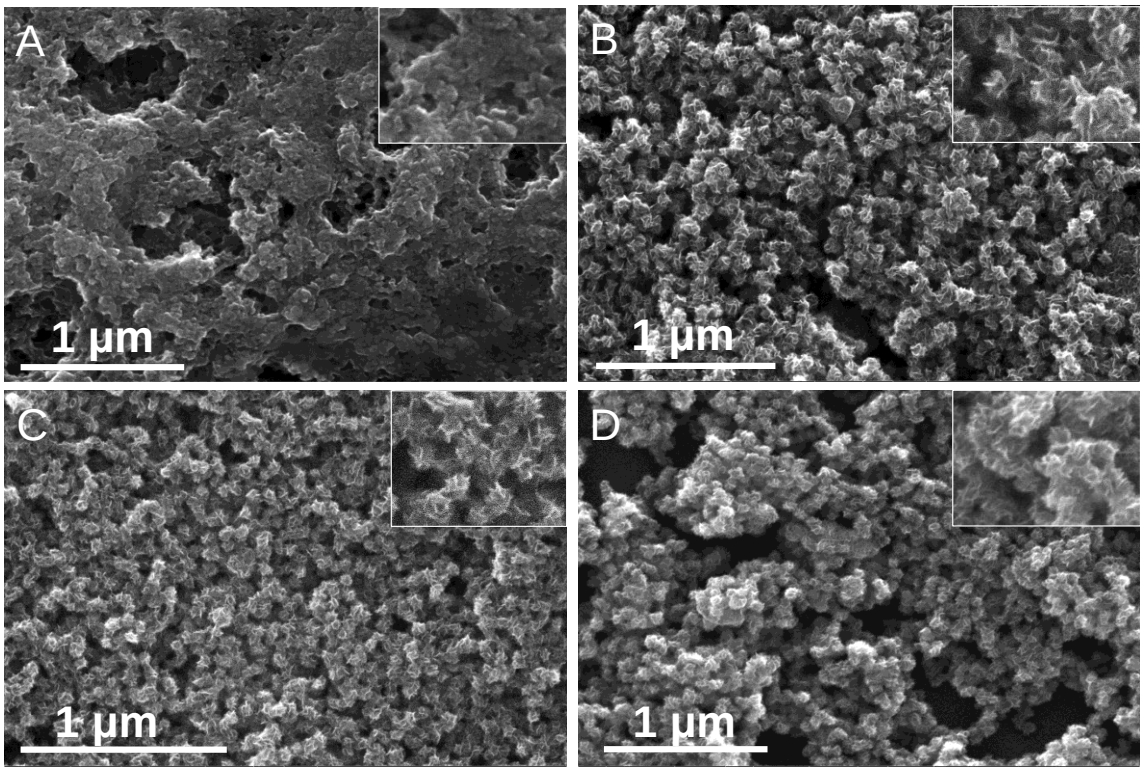

Figure S1. SEM images of IE MoS_2 nanostructures synthesized from reactions at (A) 200 ^oC, (B) 220 ^oC, (C) 240 ^oC, and (D) 260^oC in the absence of GO sheets.

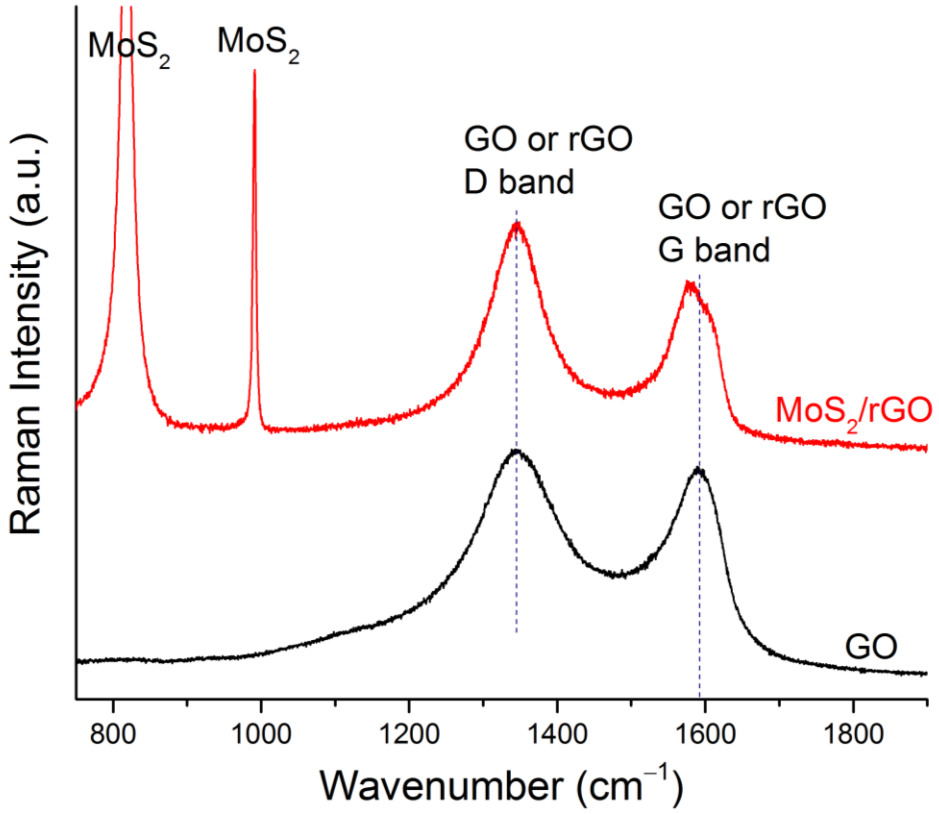

Figure S2. Raman spectra of the GO nanosheets and the MoS_2/rGO composite synthesized at 260 ^oC (as that shown in Fig. 1). The G band of the GO nanosheets exhibits a well-defined peak at 1591 cm^{-1}. The G band of the rGO nanosheets in the MoS_2/rGO composite becomes asymmetric with the major peak shift to a lower energy of 1578 cm^{-1} along with the shoulder peak. Such variation of the G band is consistent with the reduction of GO to rGO.

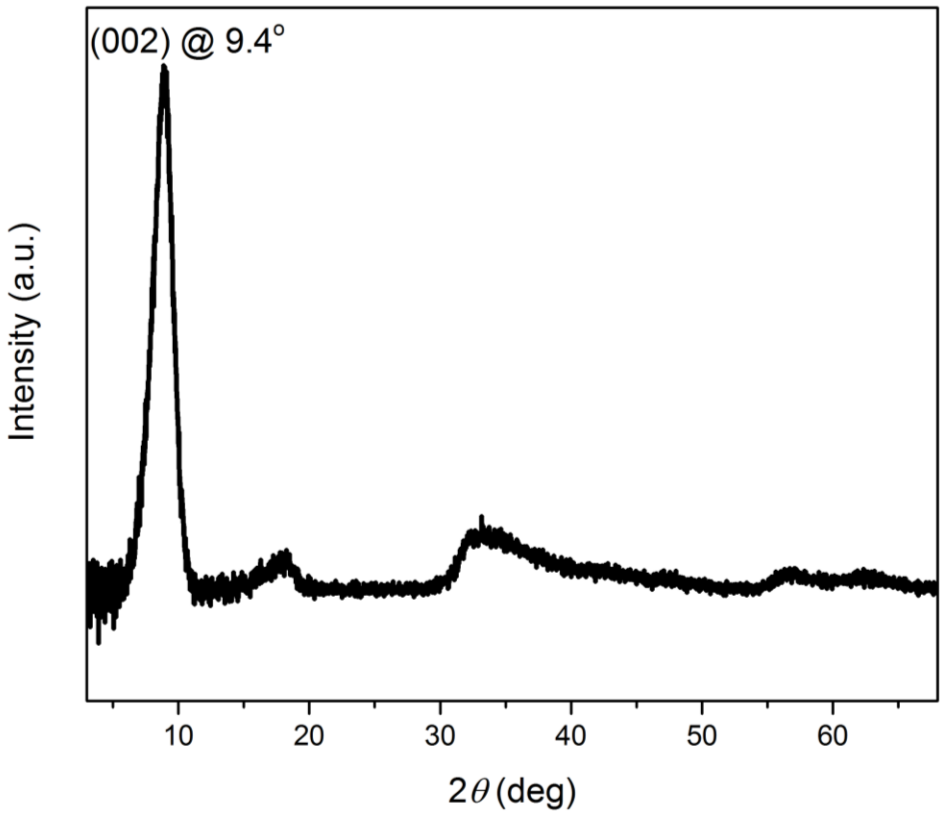

Figure S3. XRD pattern of the MoS_2 flowers synthesized in the absence of GO nanosheets. The sample is as shown in Figure S1D.

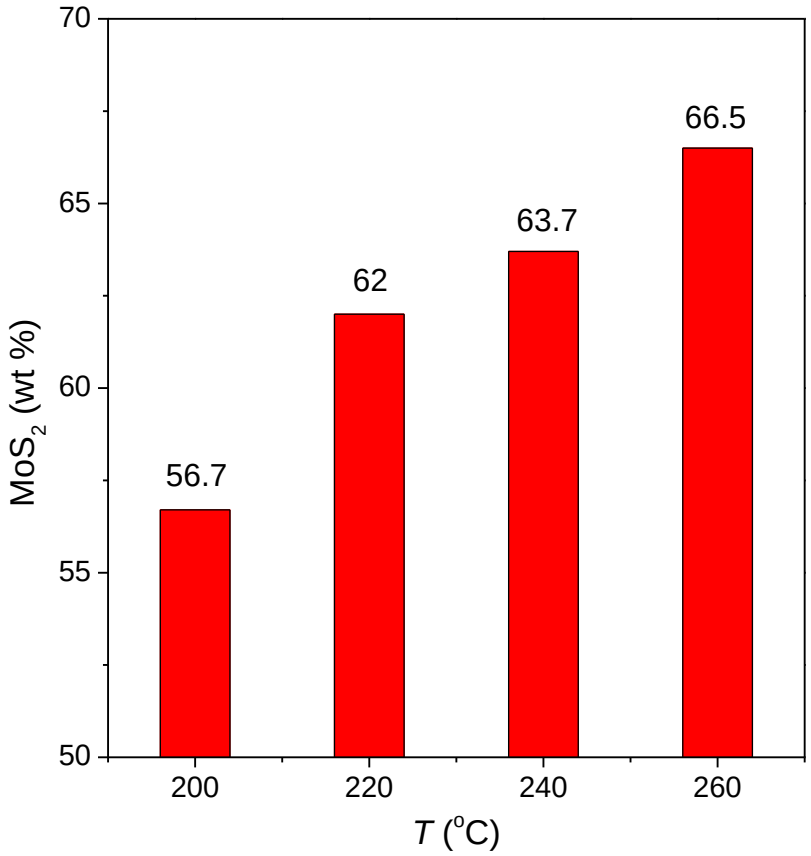

Figure S4. Weight percentage of MoS_2 in the EO&IE MoS_2/rGO samples synthesized from reactions at different temperatures.

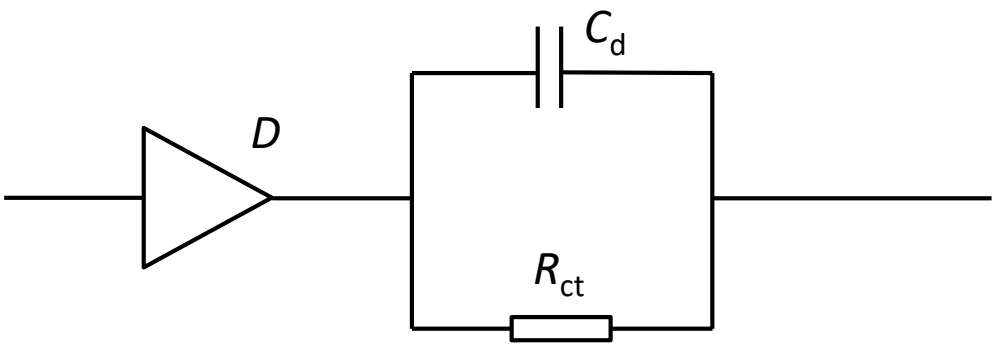

Figure S5. Equivalent circuit corresponding to HER process on the EO&IE MoS_2/rGO catalysts.