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MOLYBDENUM DISULFIDE ON REDUCED GRAPHENE OXIDE HYBRIDS WERE DEVELOPED *VIA* ONE POT HYDROTHERMAL ROUTE AS A CATALYST FOR HYDROGEN EVOLUTION REACTION

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Green hydrogen production from the cathodic reaction of water splitting (hydrogen evolution reaction) is one of the most significant discoveries in recent years. In this regard, molybdenum disulfide (MoS_2) is used as an alternative catalyst for platinum due to its high availability and lower binding energy, which is close to zero. 1-T MoS_2, 3-R MoS_2, and 2-H MoS_2 are the major phases of MoS_2, and 2-H MoS_2 is the most stable form, but only the edge sites are activated, and the whole basel plane is almost inactive. Therefore, the activity of 2-H MoS_2 is based on the nature of the edges-sites. In this study, MoS_2–graphene oxide (MoS_2–GO) composites were prepared via a one-step hydrothermal method on the three distinct GO materials, which were prepared under different oxidation durations (24, 48, and 72 h) in the modified hummer's method. The MoS_2 with differently oxidized GO was characterized by SEM, PXRD, and FTIR to disclose the characteristics of the materials. In addition, the electrochemical performance of MoS_2-GO was investigated by using linear sweep voltammetry (LSV). The results showed that MoS_2 layers were successfully grown on the surface of GO, which is prepared at the highest oxidation duration (72 h). It has a higher number of shaped edges with uniform growth. According to the FTIR results of GO and GO-MoS_2, 72 h oxidized GO has more (COOH) carboxylic groups, and the growth of MoS_2 has been initiated through COOH groups. The XRD spectrum of the MoS_2/RGO revealed that the MoS_2 prepared on 72 h oxidized GO nanosheets (MoS_2/RGO-72) had the highest d spacing value due to the inserted GO into the MoS2 layers. Moreover, MoS_2/RGO-72 was the best catalyst for the hydrogen evolution reaction (HER) because MoS_2/RGO-72 needs the lowest potential value to initiate the HER reaction (overpotential). Finally, the growth of MoS_2 on GO is possible to change by varying the oxidation duration of GO to have MoS_2/RGO material with a greater number of activated sharp edges.

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