FeS_2/MoS_2/Mo-O/Fe-O NANOWIRE HETEROSTRUCTURE AS A BIFUNCTIONAL WATER-SPLITTING CATALYST

Dawn Ford[1], Lee Kendall[2], Ali Akbari Sehat[2], Tinsae Alem[2], Adrian Kam[2], Giovanni Zangari[2], Stephen McDonnell[2]

[1]Department of Physics, University of Virginia, Charlottesville, VA 22903
[2]Department of Materials Science and Engineering, University of Virginia, Charlottesville, VA 22903

As humans prepare to return to the moon with the goal of extended visits for scientific research and discovery, technology must be developed to enable sustained life on the lunar surface. O_2 and H_2 generation via electrochemical water-splitting on the Moon's surface would provide astronauts with reliable access to fuel (H_2) and breathable air (O_2). However, the state of the art water splitting catalysts are expensive and unsuitable for extraterrestrial use. To meet the needs of the next generation of astronauts new low-cost, highly stable catalysts must be synthesized from Earth-abundant materials. Transition metal dichalcogenides (TMDs) have stood out as potential low-cost alternatives to noble metal based catalysts due to their high catalytic activity at active sites. However, the most promising TMDs, like MoS_2, suffer from a low density of catalytically active sites and limited conduction. To improve the catalytic ability of MoS_2 and develop a bifunctional water splitting catalyst, this work studies the impact of incorporating S into the lattice of $FeMoO_4$ nanowires to form a MoS_2/FeS_2/Mo-O/Fe-O nanowire heterostructure. Higher S concentrations lead to the formation of MoS_2 and FeS_2 in the crystal structure. These nanowires showed improved HER efficacy and the lowest overpotential for total overall water splitting.