Co-Ferrite Modified Hematite Films for All-Day Active Photo-Electrocatalyst Electrode in Water Splitting

Al Hamadat, Abdullah (School: AL Bassam-IGCSE)

In the modern era of the technological revolution, most energy needs are fulfilled from burning fossil fuels. They are not only depleting very fast but have adverse impacts on our environment in the form of CO2 emissions, which have reached 36 billion metric tons per year. One of the solutions to overcome this dilemma is to obtain energy from renewable resources in the most efficient way. Photo-electrochemical (PEC) water splitting is one of the easiest, cost-effective, and reliable methods that can be used to harvest renewable energy. This work aimed to fabricate a novel, efficient, and stable multi-layered hematite coated with a co-ferrite photo-electrocatalyst that continuously generates O2 and H2 by splitting water molecules. The innovative catalyst consisting of a layered structure of hematite and co-ferrite was prepared using the facile pulsed laser deposition (PLD) technique. Then, the performance of the photocatalyst was examined through various experiments, and each experiment was repeated at least three times. Linear sweep voltammetry (LSV) indicated that the hematite/co-ferrite modified electrode, at 1.6V vs. RHE, generated 1.1 mA/cm2 under light-on conditions. That is a 173% enhancement from the hematite-based photocatalyst. In addition, the modified electrode demonstrated 0.3 mA/cm2 in the absence of light, revealing excellent all-day performance to generate electric current under day and night conditions. The electrochemical impedance spectroscopy (EIS) revealed low resistance values associated with the electrode material. The catalyst demonstrated faradaic efficiency of more than 95% when used continuously for five hours.

Awards Won:
Third Award of $1,000