Reducing the Environmental Impact of Organic Dyes in Industrial Wastewater Using Modified Graphene-BiOBr Photocatalysts

Almusaed, Razan (School: AlBassam Schools)

Industrial pollution has been a major environmental concern globally. A significant type of these industrial pollutants is organic dyes, which have been found to negatively affect human health and marine life. Releasing dyes in natural media is of concern due to their high persistence, toxicity and the bioaccumulation effects on living organisms. Developing adequate techniques has become essential in ensuring the sustainability of our planet's ecosystem. This work focuses on the preparation of a graphene-based bismuth oxybromide (G-BiOBr) nanocomposite using a simple synthesis procedure. The synthesized nanocomposite material was characterized using an X-ray diffractometer, a transmission electron microscope and a UV-vis spectrophotometer. The photocatalytic efficiency of bismuth oxybromide (BiOBr) and the newly prepared G-BiOBr were examined through rhodamine-B and methylene blue dye under a visible light irradiation of 420 nm. Experimental parameters, such as contact time and dosage of the catalyst, were investigated using a central composite design, which is a factorial design augmented with a group of axial points that allows the estimation of the curvature. The results show significant improvement in efficiency of about 20%, where BiOBr nanoparticles exhibited an efficiency of 80% while G-BiOBr exhibited an efficiency of about 100%. The improvement in the photocatalytic activity can be attributed to charge separation and improved light adsorption due to introducing graphene, which plays a key role in electron transfer and reduction in electron recombination. In conclusion, synthesized G-BiOBr is capable of degrading organic dyes with a higher efficiency compared to pristine BiOBr. This can lead to improved environmental sustainability.

Awards Won:
Fourth Award of $500