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Advance nanostructured materials for photocatalytic water purification

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This water scarcity catches the eye of many researchers in field of water remediation. Since only 1% of fresh water is accessible to living beings out of 2.5% of total fresh water, perhaps the need for its purification is a major issue to our health. Various organisations are spending a ton of principle in its purification, also investing in research to find a best low cost way to cleanse the water bodies to make it available for human use and avoid various water borne diseases. Organic dye(s) is one of the major impurities found in water and is big threat to health of living beings. Numerous existing metal oxides sheets e.g. TiO_2, ZnO, SnO_2 and WO_3 usage as photocatalyst is restricted due to (i) under-utilization of sunlight for photogeneration of charge carriers due to their wide band gap, (ii) poor charge transport due to low mobility, (iii) high recombination rate of the photogenerated electron-hole pairs, thus limiting its catalytic activity, (iv) agglomeration of nanomaterials leading to poor dispersion.

In the present work, two dimensional (2D) metal dichalcogenides, MX2 (M = Mo, W; X = S, Se) are used for photocatalytic activity owing to their unique physicochemical properties such as porous structures, high specific surface areas, good crystallinity, better charge carrier separation, and abundant surface active sites. Despite all these advantages, the key drawback of employing MX_2 as a photocatalytic material is its poor electronic conductivity and agglomeration. The weak interlayer bonding and large interlayer spacing causes stacking of MX_2 nanosheets. In the present work, various approaches have been attempted to address this issue to improve conductivity and stacking including stacking with conducting polymers, graphene, coating and mixing with carbon nanotubes etc. The rationally designed two dimensional hybrid nanostructures have the potential to overcome the aforementioned challenges prevalent in existing photocatalytic material.

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