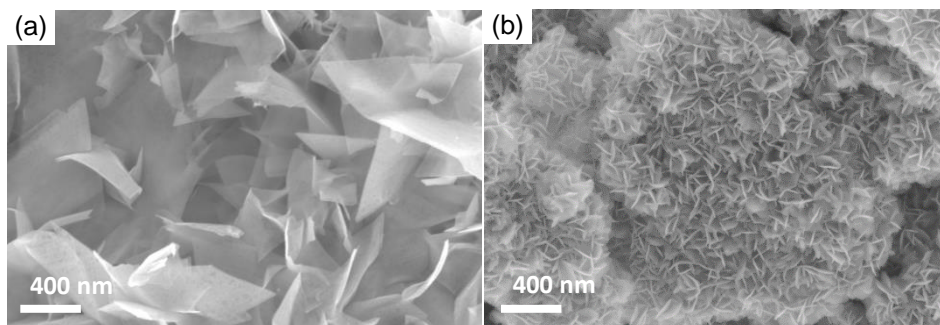


A low-cost method to Synthesize Tungsten Disulfide Nanosheets used as catalyst in petrochemical industries

Scientists at the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), an autonomous R&D Centre of Department of Science and Technology (DST), have developed an improved and commercially viable synthesis route for two-dimensional tungsten disulfide used in photocatalysts for hydrogen evolution reaction and petrochemical catalyst. These materials are potential candidates for applications in field emission tunneling transistors, Li-ion battery electrodes, and lubricants.

Two-dimensional tungsten disulfide or 2D-WS₂ has extremely low coefficient-of-friction, and this makes it a solid lubricant under high shear load in forging as well as an effective additive to automotive lubricant oil and extreme performance grease. Such remarkable range of properties and potential applications has triggered worldwide efforts, in recent years, to develop new synthesis techniques that are efficient, cost-effective, and capable of producing 2D-WS₂ in bulk quantities and reproducible quality. But most of the known methods for the generation of 2D-WS₂ either produce minuscule amounts of the product or involves high cost or lack reproducible quality.

The ARCI team developed a novel synthesis method based on a controlled temperature and pressure approach. The method showed excellent capability in the bulk synthesis of 2D WS₂ and other chalcogenides like Molybdenum disulfide (MoS₂). The team observed microstructure of the synthesized 2D-WS₂ and 2D-MoS₂ particles under a scanning electron microscope and found that the material had a high surface area of about 50 to 250 m²/g. The high surface area in these grades of powders contributes to their properties and performance.



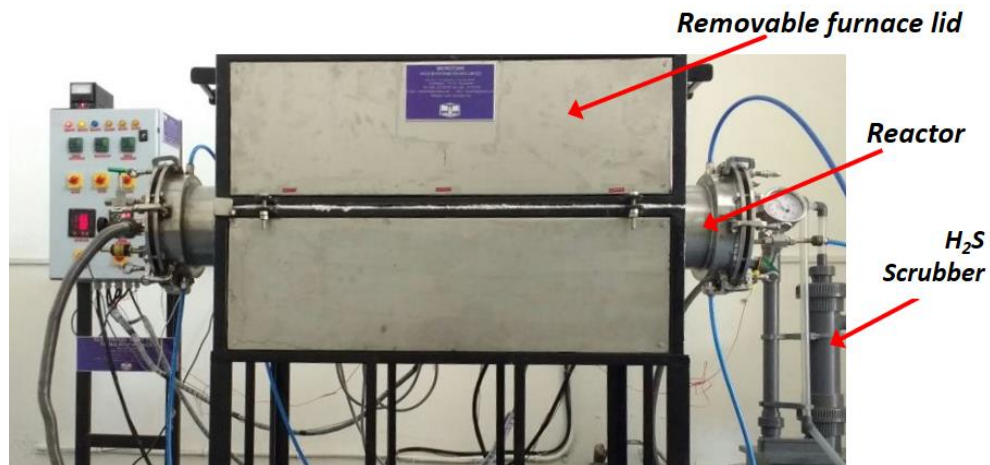
SEM pictures of (a) 2D-WS₂ and (b) 2D-MoS₂ synthesized by ARCI method

The method is cost-effective as it uses cheap raw material in the form of metal oxide powders and makes use of various commercially viable bulk production routes for nano-precursor production, like high energy ball milling and wet-chemical methods.

Further, large scale synthesis of WS₂ and MoS₂ nanosheet powder (few kilograms) by the ARCI method was successfully demonstrated using a scaled-up reactor. A pilot-scale reactor with a production capacity of up to 2 kg/day (0.5 kg/batch), has also been designed and developed

indigenously as part of a project sponsored by Hindustan Petrochemicals Limited. Further work is in progress to evolve commercial applications in the area of lubrication and catalysis.

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Reactor for 2D-WS₂ and MoS₂ synthesis developed at ARCI