

International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

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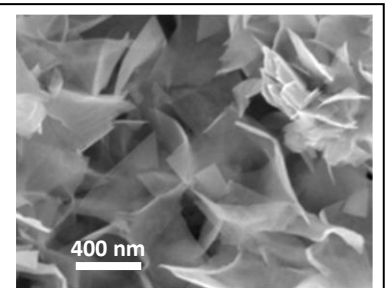
2D-Nanolayered Transition Metal Sulfides (2D-NTMS)

Overview

Two dimensional nanosheet like structure in sulfides of transition metals like tungsten and molybdenum have shown wide range of attractive properties, which can be harnessed for various applications as catalyst or lubricant in petrochemical and automotive sectors, electrode material for Li-ion batteries and electrocatalyst for hydrogen evolution reaction (HER), etc. However, the absence of commercially viable routes for their synthesis in bulk quantity and reproducible quality has been a major issue hindering their commercial exploitation. Recently, a novel technique has been developed by ARCI to generate such 2D structure in WS_2 and MoS_2 . The process offers unique control capabilities to synthesize tailor-made 2D nanolayered structure in these sulfides in bulk amount. Based on the application and/or required properties, the size and thickness of these nanosheets can be altered by changing various process control parameters.

Key Features

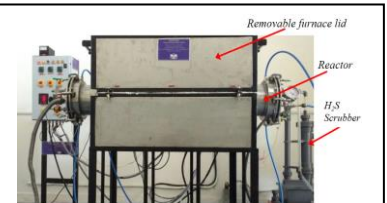
- Synthesis of pure as well as mixed WS_2/MoS_2 nanosheet powders
- Synthesis of doped- WS_2/MoS_2 nanosheet powders
- Reasonably good oxidation resistance
- Synthesis of 2D-nanostructured other transition metal sulphides feasible
- Scalable process for bulk production



Microstructure of typical 2D- WS_2 nanosheets by ARCI method

Potential Applications

- Solid lubricant for aerospace and automotive sector
- Solid lubricant for forging and other manufacturing processes
- Additive to automobile Lub-oil
- Additive to grease for improved performance under high shear stress
- Petrochem catalyst
- Electrocatalyst for HER
- Li-ion battery electrode
- Self-lubricating composites and coatings (metallic/ceramics/polymer)
- Sensors and actuators



Scaled-up reactor for bulk production of 2D- WS_2 and MoS_2

Technology Readiness Level (TRL)

- Stability in air validated at laboratory scale
- Consistency of the powder grade tested
- Scaled-up reactor successfully commissioned and tested for bulk production of 2D- WS_2/MoS_2

IPDI*	1	2	3	4	5	6	7	8	9	10
Activities	Basic concepts and understanding of underlying scientific principles	Short listing possible applications	Research to prove technical feasibility for targeted application	Coupon level testing in stimulated conditions	Check repeatability/consistency at coupon level	Prototype testing in real-life conditions	Check repeatability/consistency at prototype level	Reassessing feasibility (IP, competition technology, commercial)	Initiate technology transfer	Support in stabilizing production
Status										

*IPDI : Intellectual Property Development Indices

Major Patents / Publications

1. J. Joardar and M.S. Sylvester, Indian Patent (Ap. No. 1703/DEL/2012).

Centre for Nanomaterials (CNAM)

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