Engineered 2-Dimensional Heterostructures for Electrocatalysis

M. M. Shaijumon
School of Physics, Indian Institute of Science Education & Research Thiruvananthapuram, Maruthamala PO, Kerala, India-695551
Email: shaiju@iisertvm.ac.in

Atomically thin layered transition metal dichalcogenides (TMDs) such as MoS_2, WS_2, $MoSe_2$ and WSe_2 have been emerging as the cutting edge in materials science and engineering, due to their interesting electronic properties.[1] These materials open up new opportunities for a variety of applications, including optoelectronics, energy conversion, and catalysis. To realize their potential device applications, it is highly desirable to achieve controllable growth of these layered nanomaterials, with tunable structure and morphology. TMDs exhibit promising catalytic properties for hydrogen generation and several approaches including defect engineering have been shown to increase the active catalytic sites.[2,3] 2D heterostructures based on various 2D layered materials with distinct properties have been demonstrated to exhibit novel physicochemical properties for their potential application in electrocatalytic hydrogen production. Here we present some of our efforts on morphological and photo/electrocatalytic studies of engineered 2D nanomaterials and their heterostructures.[4-6] Controllable growth of ultra-thin triangular flakes of highly crystalline trigonal selenium (*t-Se*) and selenene/WSe_2 heterostructures for their promising photo-electrocatalytic properties will be discussed. The work further extends to explore strain-engineered TMDs and their heterostructures towards efficient electrocatalytic hydrogen evolution reaction.

References

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Figures

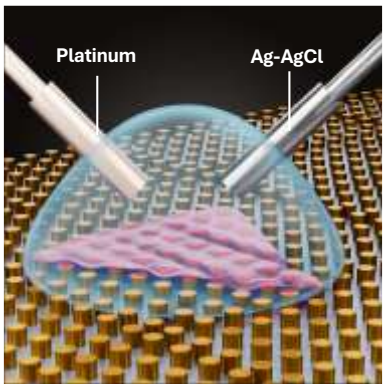

Figure 1: Schematic illustration of strained MoS_2-based microcell device employed for electrocatalytic hydrogen evolution reaction