Dottorato di Ricerca in Fisica, Università di Messina

Avviso di Seminario

Giorno 9 Gennanio 3018, ore 15.00, aula HT6-1

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2D materials for energy conversion applications

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The worldwide energy demand is continuously increasing, but the resources we are currently exploiting (coal, oil and natural gases) are either polluting and exhaustible. For these reasons, many efforts focused on finding viable and renewable sources of energy. Among these, the molecular hydrogen (H_2) produced from electrochemical water splitting has attracted growing attention due to its high energy density (between 120-140 MJ kg^{-1}) and environmental friendliness. The most effective H_2 evolution reaction (HER)-electrocatalysts are platinum-group elements, but their high cost (> 30 USD g^{-1} for both Pt and Pd) and scarcity (< 0.005 ppm of Pt and <0.001 ppm of Pd in Earth's crush) hinder massive commercial applications. Therefore, HER-electrocatalysts based on Earth-abundant and electrochemically stable materials are being pursued for viable and sustainable H_2 production prospective. In this context, two-dimensional (2D) materials, such as transition metal dichalcogenides (TMDs), transition metal oxides and graphene-based hybrids have been reported as high-performance HER-electrocatalyst both in terms of electrocatalytic activity and stability. Moreover, 2D-TMDs can be produced from their bulk crystal counterparts in suitable liquids to yield dispersions by liquid phase exfoliation (LPE). This approach allows to formulate functional inks, which can be processed by large-scale, cost-effective solution-based techniques, offering the possibility to create and design layered artificial structures possessing on-demand properties compatible with high-throughput industrial manufacturing. Therefore, the exploration of novel 2D materials, production methods and energy applications, including solar cells, (photo-)electrochemical cells, batteries and supercapacitors, is promising for facing the current energy consumption issues.