

# An insight into Laser Induced Graphene and MoS<sub>2</sub> as 2D active materials for nanotechnology applications

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Since the discovery of graphene in 2004 by Geim and Novoselov, 2D materials have attracted great attention in fundamental and applied research due to their peculiar and fascinating properties. In recent years, different incarnations of 2D materials have been theorized and experimentally obtained: transition metal dichalcogenides (TMDs), silicene, MXenes and many others [1]. From a technological perspective, there is also a great research interest in the possibility to obtain 2D materials through relatively simple, low-cost and possibly environmentally friendly techniques.

This talk provides a focus on two different studies of 2D materials and their potential technological applications which are currently carried out by Istituto Italiano di Tecnologia in collaboration with Politecnico di Torino.

Specifically, the first part of the talk is devoted to Laser Induced Graphene (LIG): three-dimensional structures constituted of randomly oriented few-layer graphene obtained by laser-irradiation of suitable polymeric substrates [2]. The conversion into LIG of different starting polymers (polyimide, SPEEK, polydimethylsiloxane – polyimide composites) is discussed; moreover, the possibility of decorating the LIG three-dimensional architecture with nanostructures with functional properties is examined.

The second part of the talk is centred on MoS<sub>2</sub>, a TMD with interesting physical and chemical properties which make it a promising candidate for a wide variety of applications: optoelectronics, sensors, energy storage [3]. An environmentally friendly hydrothermal synthesis of few-layer MoS<sub>2</sub> nanoflakes is introduced. Careful structural and chemical analysis reveals that the nanoflakes exhibit a complex structure based upon the co-existence of the 2H (semiconducting) and 1T (metallic) polymorphs. The effects of the mixed-phase structure on MoS<sub>2</sub> properties and their potential applications are discussed.

1. “Recent Advances in Growth of Novel 2D Materials: Beyond Graphene and Transition Metal Dichalcogenides” *Adv. Mater.* 2018, 30, 1800865
2. “New insights on laser-induced graphene electrodes for flexible supercapacitors: tunable morphology and physical properties”, *Nanotechnology* 28 (2017) 174002
3. “Two-dimensional layered MoS<sub>2</sub>: rational design, properties and electrochemical applications”, *Energy Environ. Sci.*, 2016, 9, 1190