Materials Science Seminar

03/11/2022 15.30

Grassano room

Nanoscale Engineering of emerging Two-Dimensional Materials

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Isolation of graphene is a milestone in condensed matter physics that paves the way to a new and unprecedentedly rich fashion of two-dimensional (2D) materials. While many of them are derived through exfoliation methods, an urgent need remains as to how to synthesize them through scalable schemes and manipulate in diverse configurations by design. Here I will show several bottom-up approaches to the controlled synthesis and manipulation of 2D materials beyond graphene. I will start with the case of Xenes, the natural followers of graphene as they are 2D crystal made by single atoms [1]. I will show how large area Xenes can be produced through epitaxial methods by leveraging on a tailored choice of the growth conditions [2], and how they may ultimately end up in multiple Xene combinations inside epitaxial heterostructures [3] for further processing [4]. On the other hand, I will show how the chemical vapor deposition of transition metal dichalcogenides can be developed to achieve wafer-scale nanosheets for integration into electronic devices [4], and designed so to have nano- and meso-structured materials with a full control of the shape, strain, and anisotropy thereby enabling applications in plasmonics, energy harvesting, and catalysis [5]. In the end, I will bring the discussion to the manipulation of the above-mentioned 2D materials to extreme bendable layouts so as to prove their versatility to be used in flexible substrates or configurations.

[1] C. Grazianetti et al., Phys. Stat. Sol. RRL (2019), 14, 1900439.
[2] A. Molle et al., Chem. Soc. Rev. (2018) 47,6370.
[3] D. S. Dhungana et al., Adv. Funct. Mater. (2021) 31, 2102797.
[3] C. Martella et al, Adv. Funct. Mater. (2020) 30, 2004546.
[4] C. Martella, et al., Adv. Mater. Interf. (2020) 7, 2000791.
[5] C. Martella et al., Adv. Mater. (2018), 30, 1705615; C. Martella, et al., Nano Res. (2019) 12, 1851.