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Seminar room, DFA

Scientific Seminar

2D Layered Thin Films for Solid-State Hydrogen Storage

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Hydrogen holds immense potential as a key player in energy storage, unlocking the full benefits of renewable and sustainable energy sources. However, traditional storage methods for hydrogen present significant obstacles to wider adoption. Compressed gas storage requires high pressures, while liquid hydrogen necessitates cryogenic temperatures. These limitations necessitate the development of novel materials for solid-state hydrogen storage.

Our research explores 2D layered materials, such as α-MoO3 thin films grown using atomic layer deposition (ALD), as promising materials for reversible hydrogen storage. We developed a novel precursor delivery method to achieve high-quality α-MoO3 films by ALD. These films were then investigated for solid-state hydrogen storage. We found that hydrogen plasma offers a convenient way to infuse hydrogen into the layered α-MoO3 films at room temperature and relatively low pressure (a few hundred mTorr). The study reveals that hydrogen preferentially resides within the van der Waals gap of the [010] oriented α-MoO3 film. The volumetric hydrogen storage capacity of 28 kg.m−3 achieved in our films is comparable to that of pressurised steel cylinders, highlighting their potential for practical applications. Our essay could be a starting point to a transition from conventional (gas and liquid) to more advantageous solid-state hydrogen storage materials.

Since 2012, Dr. Massimo Cuscunà has been a scientist at the Institute on Nanotechnology (NANOTEC) of the National Research Council (CNR), where he currently leads the Nanofabrication Facility. He holds a PhD in Physics from the University of "Roma TRE" obtained in 2006. He has published over 75 peer-reviewed papers and holds 2 international patents. His current research centers on several crucial areas with significant implications for the future:

1) Hydrogen storage in solid-state systems,
2) Plasmonic and chiral nanostructures for biosensing,
3) Optical and electron correlative microscopy applied to life science.

He actively represents his country in international organizations:

-NFFA-Europe-Pilot: this research infrastructure unites several European countries, providing a platform for large-scale, multidisciplinary research projects at the nanoscale,

-EuroNanoLab: this infrastructure offers world-class expertise and tools for nanofabrication across Europe,

-NanoWorldMaps: this distributed research infrastructure leverages multiple electron beams to achieve nearly 100-fold faster image acquisition speeds.

He serves as the CNR-NANOTEC unit coordinator for various projects funded by national research programs (PRIN and PNRR).

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