Seminars at the Department of Chemistry and Industrial Chemistry

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Dr. **Beatriz Martín-García**

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CV:

Education: 2013, PhD in Chemical Physics, University of Salamanca, Spain

Academic Career:

- ***2022 – to date***: Ikerbasque Research Fellow at Nanodevices group, CIC nanoGUNE BRTA, Spain.
- ***2020-2022***: Gipuzkoa Research Fellow at Nanodevices group, CIC nanoGUNE BRTA, Spain.
- ***2014-2020***: Postdoctoral researcher – Graphene Flagship, Nanochemistry department – Graphene Labs, Istituto Italiano di Tecnologia, Italy.

Invited Conferences: 4 invited conferences.

Publications: 80 peer-reviewed publications, 2 patents (one under exploitation by ENEL).

Awards & fellowships:

2023 Ramón y Cajal Fellowship from National Research Agency – Ministry of Education & Science (Spain); **2022** Ikerbasque Research Fellow from Ikerbasque – Basque Foundation for Science (Spain); **2020** Gipuzkoa Fellow for talent attraction and retention. Gipuzkoa Council (Spain); **2019** Best poster prize at Graphene Week 2019; **2008** University of Salamanca (Spain) Extraordinary master's degree award (Minor thesis).

Current projects as PI:

2022-2025: Hybrid layered materials for nanodevices (HiMat) co-PI with Dr. M. Gobbi - PID2021-128004NB-C21. MICIN (Spain).

2022-2027: Rational design of low-dimensional and hybrid organic-inorganic materials for optoelectronic and spintronic applications (HYMNOS). IKERBASQUE.

Martedì 14 Novembre 2023, h. 16.00

Online sul Team "Seminari Dipartimentali DCCI"

Modulating optical and magnetic properties in layered organic-inorganic metal halide perovskites

Abstract

The development of new technologies has been always accompanied by the access to functional materials with targeted and exceptional properties. Among these materials, layered hybrid organic-inorganic metal halide perovskites (HOIPs) outline a prospective path for their potential application in optoelectronic and spintronic devices. Indeed, HOIPs are an ideal platform for optical (photons) and magnetic (spins) tunability due to their chemical and structural versatility.[1–3] However, for their successful integration into devices, it is key to understand the relationship among composition, crystal structure and optical/magnetic properties and how to control them. In this line, two case studies are presented. The first one is focused on modulating the photoluminescence (PL) by strain engineering. We report the tuning of the micro-PL emission of 2D lead-bromide HOIP flakes subject to biaxial strain. To generate the mechanical strain, we placed the flakes by viscoelastic stamping on a rigid SiO_2 ring platform, leading to the formation of domes. At low temperatures, we found that a strain < 1% can change the PL emission spectrum from a single peak (unstrained) to three well-resolved peaks. Combining temperature-dependent micro-PL and Raman spectroscopy[4] mapping and reverse mechanical engineering strain modeling, we confirm that the emergence of the two new PL peaks is related to tensile and compressive thermo-mechanical strain along the flake surface and thickness.[5] Our findings provide new insight into strain-based optoelectronic and sensing devices using 2D HOIPs, leveraging on the material composition selection and substrate platform design. The second case deals with the control of the magnetic properties by varying the transition metal (Cu^{2+}, Mn^{2+} and Co^{2+}), organic spacer (alkyl- and aryl-ammonium) and perovskite phase (Ruddlesden-Popper and Dion-Jacobson). We show that for Cu^{2+} HOIPs, an increase of in-plane anisotropy and a reduction of the interlayer distance changes their behavior from a 2D ferromagnet to a quasi-3D antiferromagnet. In contrast, the magnetism of Mn^{2+} HOIPs is intrinsically antiferromagnetic and Co^{2+} crystals present a dominant paramagnetic behavior. Therefore, our findings demonstrate that the chemical flexibility of HOIPs can be exploited to develop novel layered magnetic materials with tailored magnetic properties.[6]

References:

(1) Chen, Y. *et al.*, *Adv. Mater.* **2018**, *30*, 1703487.
(2) Pan, X. *et al.*, *J. Chem. Phys.* **2020**, *152*, 044714.
(3) Martín-García, B. *et al.*, *Adv. Opt. Mater.* **2022**, *10*, 2200240.
(4) Spirito, D. *et al.*, *J. Phys. Mater.* **2022**, *5*, 034004.
(5) Spirito, D. *et al.*, *Nano Lett.* **2022**, *22*, 4153–4160.
(6) Asensio, Y. *et al.*, *Adv Funct Materials* **2022**, 2207988.

To find out how to reach the Department, go to **http://www.chimica.unige.it**. For further informations on this specific seminar contact **Prof. Serena De Negri** (e-mail: **serena.denegri@unige.it**)