ORGANIZATION OF MAGNETIC NANOPARTICLES ON 2D MATERIALS FOR INNOVATIVE TRANSPORT PROPERTIES

LABORATORY : Institut Lumière Matière

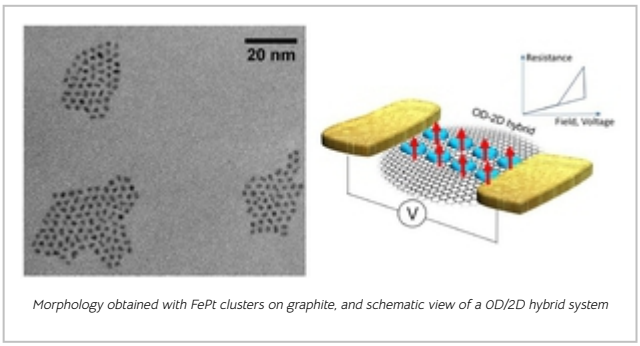
LEVEL : M1 / M2 / L3
TEAM(S) : ENERGIE

CONTACT(S) : BARDOTTI Laurent
TOURNUS Florent

CONTACT(S) DETAILS: laurent.bardotti[at]univ-lyon1.fr / Tel. 0472431996
florent.tournus[at]univ-lyon1.fr / Tel. 0472432831

KEYWORD(S) : Nanoparticle / 2D materials / electronic structure

SCIENTIFIC CONTEXT :



Morphology obtained with FePt clusters on graphite, and schematic view of a 0D/2D hybrid system

Hybrid 2D/0D systems (nanoparticles on a 2D material) are appealing in many domains, but potential applications require good understanding and control of the cluster film morphology, reflecting the particle-surface interaction. While the use of metallic atoms/clusters as surface adsorbates is among the best methods to tailor electronic transport behavior of a 2D material, assemblies of nanoparticles in themselves can offer "exotic" transport properties (for instance, percolating systems can display a memristive behavior). Moreover, in the case of nanomagnets, inter-particle coupling can be used to build micro or even nanoscale logic gate architectures for information manipulation and transfer, and even the magnetization fluctuations of superparamagnetic nanoparticles can be turned into a benefit in the frame of stochastic computing. Besides, 2D materials offer a perfect playground to study surface diffusion and self-organization of preformed nano-objects. These processes can be used efficiently to produce a bottom-up organization of nanoparticles (with local or long-range order) [1].

MISSIONS :

In this framework, we propose a new project (ANR project in collaboration with IPCMS Strasbourg and IS2M Mulhouse) targeting the elaboration and study of structural, electronic and magneto-transport properties of innovative hybrid nano-systems made of size-selected magnetic nanoparticles (FePt clusters) deposited on 2D materials (graphene and MoS2), taking benefit from: the electronic properties of a 2D substrate; specific behavior of nanomagnets; interface/coupling effects; and controlled particle organization on the surface. The internship, based on experimental investigations (cluster deposition under ultra-high vacuum, electron microscopy & AFM, spectroscopy, transport/magnetotransport measurements), will address some questions related to this ambitious project: how can we control the diffusion and organization of nanomagnets deposited on graphene or MoS2? How the resulting systems display modified electronic structures and specific transport properties?

OUTLOOKS :

The work may be continued with a PhD thesis, with a possible funding through an ANR project.

BIBLIOGRAPHY :

[1] P. Capiod et al., "Elaboration of Nanomagnet Arrays: Organization and Magnetic Properties of Mass-Selected FePt Nanoparticles Deposited on Epitaxially Grown Graphene on Ir(111)", Phys. Rev. Lett. 122, 106802 (2019)

published on 17/01/2022