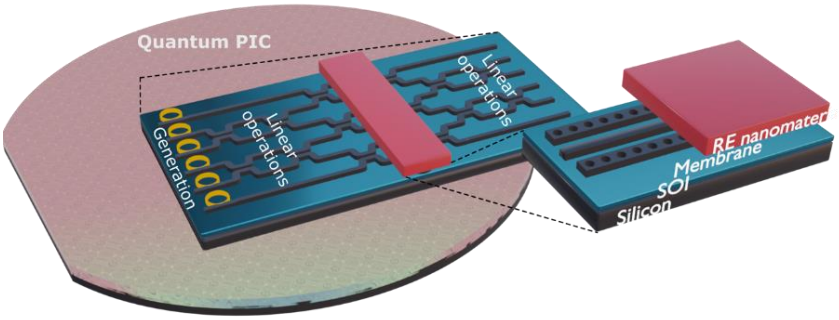
Open PhD position

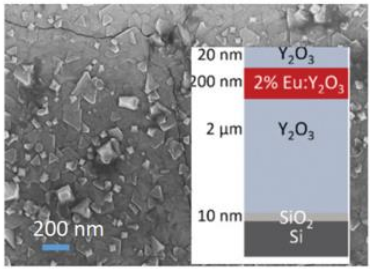
Crystalline membranes for quantum technologies

The *Crystals and Quantum State Dynamics* group seeks motivated and talented PhD students to join our team developing novel nanomaterials for **quantum technologies**.
The project aims to pioneer a hybrid interface merging rare-earth doped nanomaterials with superconducting circuits, catalyzing advancements in quantum storage and transduction applications. Implementing such a novel material platform will open prospects for realizing efficient hybrid structures compatible with superconducting qubits and useful for integrated quantum information processing.



Objectives: Develop novel crystalline thin films compatible with silicon integration, housing active magnetic and optical centers. Realize a nanophotonic interface to study optical and spin coherent properties and a couple of rare-earth ion ensembles with superconducting circuits.

Methodology: The growth optimization and coherent spectroscopic characterization of rare-earth ions doped thin films grown by direct liquid injection chemical vapor deposition (DLI-CVD) will be implemented.



We will employ advanced techniques such as nanostructuring via laser and electron beam lithography to facilitate nanophotonic interfacing of the novel platform. This approach will enable the integration of rare-earth ion-doped nanomaterials onto the chip, thereby harnessing their coherent optical transitions.

Furthermore, we will address the spin properties of the rare-earth ion ensemble by patterning superconducting resonators on crystalline membranes. We aim to explore spin coherence time and minimize the decoherence processes of the platform, facilitating efficient interfacing between optical and microwave domains.

The project represents a significant step towards bridging the gap between rare-earth doped nanomaterials and superconducting circuits. The photonic integration and interface with superconducting circuits will constitute an enabling step towards an integrated, long storage time, quantum memory interface of paramagnetic ions with superconducting circuits.

The PhD student's tasks will include the following:
- Learning about using solid-state spin ensembles for quantum information applications ;

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- Acquiring the fabrication skills to develop nanomaterials based on thin films (atomic layer deposition and chemical vapour deposition, spin coating etc.);
- Studying developed samples using optical spectroscopic techniques at cryogenic temperatures;
- Designing and fabricating novel nanophotonic interfaces using clean-room fabrication/ processing (lithography, reactive ion etching etc.).

Candidate's profile :
We are looking for candidates with a background in Nanoscience, Applied Physics, and Optical or Electrical Engineering. Applicants are expected to have:
- Background in optics, solid-state physics, or optoelectronics, including experimental skills;
- Basic knowledge of quantum physics and quantum information;
- Interest in experimental work and nanofabrication (previous experience working in chemical labs/cleanrooms is a plus);
- Ability to work independently and in daily collaboration with the research team.

Presentation of the host institution and host laboratory
The project will be realized at the Crystals and quantum State Dynamics (*cqsd.fr*) group at IRCP MPOE, renowned for its expertise in synthesizing state-of-the-art rare-earth ion-doped materials and pioneering the study of coherent properties of nanomaterials doped with rare-earth ions. Recently, thin film materials exhibiting exceptional coherent properties in the optical domain have been realized, making them highly promising for integrated quantum technologies.

The group is a part of the Material for Photonics and Opto-Electronics (MPOE) team of the Institut de Recherche de Chimie Paris, located in Paris. We offer creative and stimulating working conditions in a dynamic, international research environment. Our research facilities include modern optical laboratories and fabrication facilities to synthesize nanomaterials.

Place of work
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Contact information
For further information and to apply, please send an email including your CV and motivation letter to:
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