

## PhD Position – Colloidal Synthesis of 2D SnS/SnSe Nanosheets: growth mechanism and ferroelectric properties

Sorbonne Université – MONARIS Laboratory (Paris, France)

**Supervision:** Alexa Courty (Prof.) – Co-supervision: Isabelle Lisiecki (CNRS)

**Start date:** October 2026 | Duration: 36 months

### Project overview

Group IV chalcogenides such as tin sulfide (SnS) and tin selenide (SnSe) nanosheets are emerging two-dimensional semiconductors exhibiting thickness-dependent ferroelectric properties, with strong potential for nanoelectronics and energy devices. However, reliable and scalable syntheses of ultrathin nanosheets with fine controlled thickness remain challenging.

This PhD project aims to develop a controlled colloidal synthesis route of few-layer (1–10 layers) SnS and SnSe nanosheets while providing a detailed understanding of their nucleation and anisotropic growth mechanisms. The ultimate goal is to establish clear structure–property relationships between nanosheet thickness, crystal structure, and ferroelectric behavior.

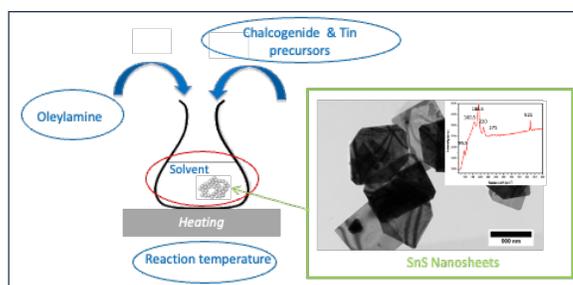


Figure 1. Schematic illustration of the colloidal synthesis process of SnS nanosheets and the corresponding TEM image. Inset: Raman spectrum confirming phase purity.

### Research objectives

- Develop reproducible colloidal routes to synthesize phase-pure SnS and SnSe nanosheets with controlled thickness
- Elucidate nucleation and growth mechanisms of these 2D nanostructures
- Investigate the relationship between nanosheet morphology, thickness, and their resulting ferroelectric properties.

### Methodology

- Colloidal synthesis based on tunable ligand and precursor chemistry
- Structural and morphological characterization (TEM/HRTEM, AFM, Raman, XRD)
- In situ liquid-cell electron microscopy (LCEM) to monitor nucleation and growth in real time
- Local ferroelectric measurements by piezoresponse force microscopy (PFM)

### Environment

The MONARIS laboratory has strong expertise in colloidal nanochemistry and advanced microscopy providing an excellent experimental environment. The project benefits from established national and international collaborations, including a partnership with Prof. Eli Sutter (University of Nebraska–Lincoln, USA) for advanced in situ electron microscopy and ferroelectric measurements.

### Candidate profile

Master’s degree in chemistry, physical chemistry, or materials science. Interest or experience in nanomaterials synthesis and characterization (TEM/AFM/Raman) is highly desirable. Curiosity, autonomy, and strong experimental skills are expected.

### Contacts

Alexa Courty – [alexa.courty@sorbonne-universite.fr](mailto:alexa.courty@sorbonne-universite.fr)

Isabelle Lisiecki – [Isabelle.lisiecki@sorbonne-universite.fr](mailto:Isabelle.lisiecki@sorbonne-universite.fr)