Master project: **Au flakes in lithographically confined geometries**

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Laboratory of Quantum Nano Optics by Prof. Galland, https://www.epfl.ch/labs/lqno/
Project type: Master thesis or Internship
Start date: Fall 2026 or sooner
Deliverables: Thesis or final report and defense or presentation

Motivation

Crystalline gold flakes feature atomically smooth surfaces. resulting in better optical properties compared to poly-crystalline sputtered films [1]. See Figure 1a) and b) showing SEM images of a crystalline gold flake, versus the roughness of a sputtered film in the holes of Figure 1c).

This smoothness allows the precise fabrication of plasmonic resonators and antennas with better performance than their polycrystalline counterparts [1]. However, the direct integration of other high quality crystalline materials into the patterned structure is difficult, as they would need to be grown within the gold flake. To overcome the latter challenge, in this project we would like to explore the feasibility of growing gold crystals in confined gap geometries, as recently presented in [2]. This would allow us to combine the properties of high-quality crystalline materials, such as lithium niobate or hexagonal boron nitride, with those of crystalline gold structures.

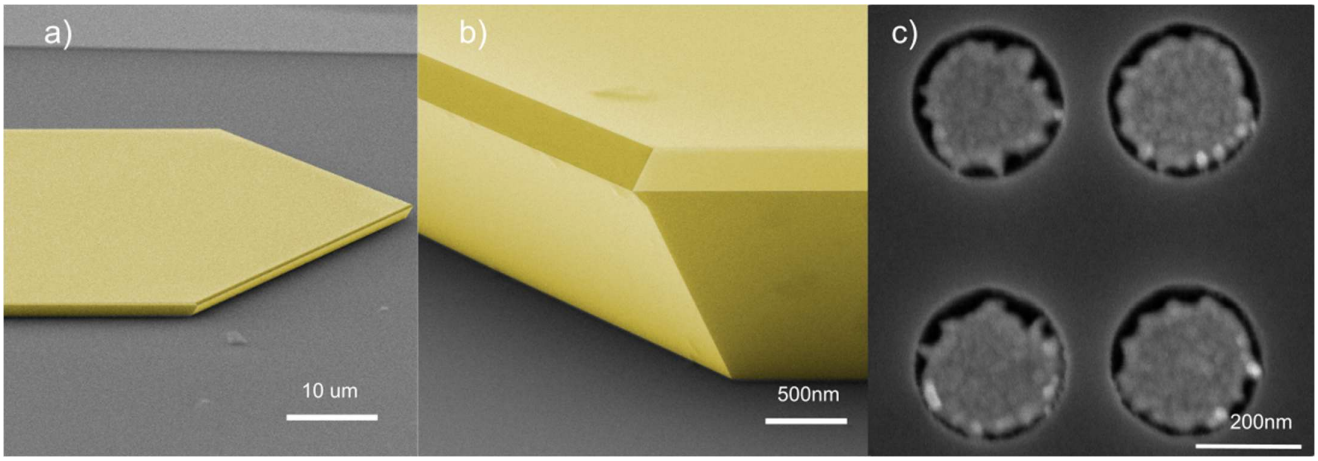

Figure 1 a) Sem image of crystal gold flake, b) zoom in showing the atomic smoothness of the surface. 1c) by comparison polycrystalline film deposited by evaporation into prepatterned holes in SiO_2 is much rougher featuring several grains. a), b) adapted from 1).

Tasks

The student will in a first step replicate the findings of [2], preparing first the gold seeds in a patterned substrate and subsequently growing the au nanocrystal first in an unconfined template and then a confined template, this involves clean room work such as UV-lithography or RIE etching, but also the use of SEM to characterize the crystals. In a second step the student will add integrate the gold structures with other crystalline materials.

We are looking for motivated students preferably with a background in material science, chemistry, micro-nanofabrication or similar. If you are interested by the project and you want to know more, please do not hesitate to contact us, we are looking forward to hearing from you.

[1] Boroviks, Sergejs, Siarhei Zavatski, Thorsten Feichtner, et al. “Crystalline Metal Flakes: Platforms for Advanced Plasmonics and Hybrid 2D Material Architectures.” arXiv:2604.22988. Preprint, arXiv, April 24, 2026. https://doi.org/10.48550/arXiv.2604.22988.

[2] Panda, Debasish, Md Rashed Nizam, Walker J. Tuff, et al. “Template-Confined Synthesis of Shape-Engineered Single-Crystal Gold Microplates in Lithographically-Defined Polymeric Patterns.” *Advanced Functional Materials* https://doi.org/10.1002/adfm.76188.