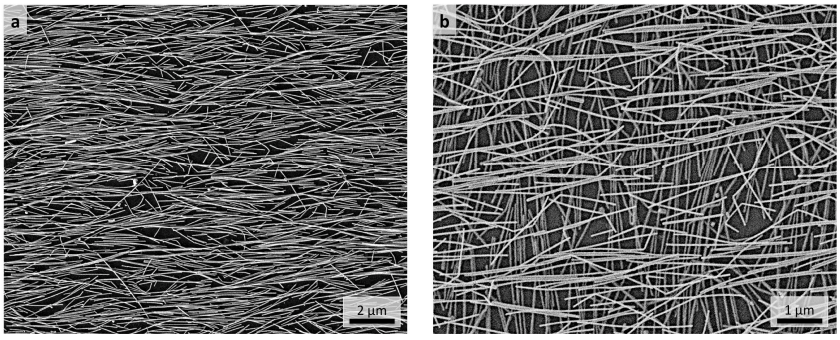
Anisotropic optical properties of oriented metal nanowires/nanorods thin films

DIRECTEUR DE THESE : MATTHIAS PAULY & GERO DECHER
INSTITUT CHARLES SADRON, 23, RUE DU LOESS, 67034 STRASBOURG
TEL : 03 88 40 40 41 ; E-MAIL : MATTHIAS.PAULY@ICS-CNRS.UNISTRA.FR

Significant progress has been made in the area of nanowire and nanorods synthesis and device application in the past several years [1]. A big challenge, however, still resides in the hierarchical organization of these nanoscale building blocks into functional assemblies and ultimately a useful system. Discovering new bottom-up methods to assemble one-dimensional nanomaterials into two- or three-dimensional structures with well-controlled location, orientation, and spacing across multiple length scales has attracted lots of attention, owing to the potential applications in electronic and optical devices [2]. The interesting optical attributes of metal nanoparticles are due to their unique interaction with light, namely surface plasmon resonance. Recently there has been great interest in developing materials that could control the flow of electromagnetic waves in unprecedented ways. Metallic self-assembled nanoparticle arrays have numerous potential applications such as Surface-Enhanced Raman Spectroscopy (SERS), plasmon-enhanced fluorescence or on-chip waveguiding.



SEM pictures of aligned silver nanowires
a) in a dense monolayer and
b) in a bilayer in which the second layer is aligned perpendicular to the first one.

The scope of this PhD thesis is to build mono- and multilayer thin films composed of oriented metallic nanowire and nanorods and to study their optical properties. For this, a novel method developed in our team which allows the alignment of anisotropic nano-objects will be used (see Fig. 1). The Layer-by-Layer assembly technique [3] will be used to fine-tune the thin film architecture. Finally, the optical properties as function of the thin film geometry will be investigated.

This multidisciplinary thesis, at the frontier between nano-chemistry, materials science and solid state physics will involve both synthesis and physicochemical characterisation.:

[1] P. R. Sajanlal et al., Nano Rev. **2**, 5883 (2011).
[2] L. Xu et al., Chem. Soc. Rev. **42**, 3114-3126 (2013)
[3] G. Decher, Science **277**, 1232-1237, (1997)