Condensed Matter and Nanophysics — Internship projects

Conductivity model of random networks of silver nanowires

Advisor: **Yann LEROY**, Assistant Professor (HDR), UdS

Contact: ☎ 03 68 85 44 26 ✉ yann.leroy@unistra.fr

Affiliation: **ICube Laboratory**, D-ESSP,
MaCEPV team (Materials for electronic and photovoltaic devices)
Physical modeling of charge transport group

Address: **Télécom Physique Strasbourg**, ICube – MaCEPV,
300 Bd Sébastien Brant, BP 10413,
67412 ILLKIRCH Cedex, France

Collaboration: **RBnano**, c/o IPCMS,
23, rue de Loess,
67034 Strasbourg Cedex 2, France

Summary:

Transparent conductor materials are of great importance for numerous technology**technologic?** applications such as the thin-film solar cells, or the organic light emitting diodes (OLEDs). One of the current challenge is the replacement of the Indium Tin Oxyde (ITO) which dominated the field of transparent electrodes over past years despite his lack of flexibility and his high price.

Various approaches are investigated, including other transparent conductor oxides, single-walled carbon nanotube networks, graphene, conducting polymers, and metal grids or thin films, in order to obtain flexible transparent electrodes with optical and electrical properties equivalent to those of ITO. Among the latter, the random networks of silver nanowires (Ag NWs) **show** promising results.

Within this framework, the aim of the internship is to develop a physical model of such a random network of Ag NWs, as only few numerical models exist up to now. Once developed, the model should allow the extraction of the conductivity of the network with respect to various topological parameters like the nanowire lengths or diameters, the nanowire density, and the nanowire-nanowire contact properties.

The model will be confronted **with** experimental measurements made by RBnano's team on **its** own Ag NWs thin film conductors, as well as to the literature. Further simulations will then be carried out in order to determine the optimal experimental parameters allowing to obtain conductors with both a good conductivity and a high transparency.

References:

- A. Kumar and C. Zhou, *The Race To Replace Tin-Doped Indium Oxide: Which Material Will Win?*, *ACS Nano*, 4(1), 11-14 (2010).
- R.M. Mutiso *et al.*, *Integrating Simulations and Experiments To Predict Sheet Resistance and Optical Transmittance in Nanowire Films for Transparent Conductors*, *ACS Nano*, 7(9), 7654-7663 (2013).
- S. Coskun *et al.*, *Optimization of silver nanowire networks for polymer light emitting diode electrodes*, *Nanotechnology*, 24(12), 125202 (2013).