Exploring new routes to make metallic nanowires with DNA

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PhD may follow: Yes

Summary :

Due to the nanometric diameter of a DNA helix (2 nm), this biological molecule appears as a promising scaffold for metallization and low-cost production of metallic nanowires. Since the very first proof-of-concept published 20 years ago, many efforts have been made to explore new routes enabling thinner DNA-based nanowires, with higher conductivity. This internship research project aims at developing a new alternative approach based on Atmospheric Pressure Spatial Atomic Layer Deposition (AP-SALD).

Full description :

DNA is a biological polymer whose length, self-assembling and structure can be easily designed and tunned by chemists. It is also considered as an exciting material by nanotechnologists as the diameter of a double-stranded DNA is 2 nm, and can thus be used to create 1D, 2D and 3D structures. This molecular object is used, for 20 years now, as a tunable scaffold to create metallic nanowires in "bottom-up" approaches. Most results published so far in this field involved metallic ion reduction in solution, and had to face with a compromise between the nanowire diameter (expected to be small) and the conductivity (expected to be high). In this context, we wish to explore how alternative approaches, like Atmospheric Pressure Spatial Atomic Layer Deposition (AP-SALD), might be used for DNA-templated vapor deposition of metals. This project will be shared by two laboratories of the Grenoble Scientific Polygone campus, the Laboratory in Materials Science and Physical Engineering (LMGP, http://www.lmgp.grenoble-inp.fr/welcome-to-lmgp/laboratory-in-materials-science-and-physcical-engineering-527707.kjsp) and the Laboratory for Systems made of Molecules and nanoMaterial for Energy and Health (SyMMES, http://inac.cea.fr/en/Phocea/Vie_des_labos/Ast/ast_service.php?id_unit=1148). This multi-disciplinary internship will enable the student to work on biomolecule engineering, surface chemistry, atomic layer deposition and use the dedicated characterizing techniques available in both laboratories.

Related Publications

1. Chen, Z.; Liu, C.; Cao, F.; Ren, J.; Qu, X., DNA metallization: principles, methods, structures, and applications. Chem Soc Rev 2018, 47 (11), 4017-4072.

2. Brun, C.; Elchinger, P. H.; Nonglaton, G.; Tidiane-Diagne, C.; Tiron, R.; Thuaire, A.; Gasparutto, D.; Baillin, X., Metallic Conductive Nanowires Elaborated by PVD Metal Deposition on Suspended DNA Bundles. Small 2017, 13 (33).

3. D. MuÃ±oz-Rojas, . J. L. MacManus-Driscoll, Spatial Atmospheric Atomic Layer Deposition: A new laboratory and industrial tool for low-cost photovoltaics. Materials Horizons, 1, 314-320, 2014.

Requested skills :

The candidate must have a good ranking (top 25%) in master or engineering school. He must be highly interested by multidisciplinary domains, e.g. material chemistry & surface characterization and the will to learn basics in biology e.g. electrophoresis purification. Ideally, (s)he should have some experience in surface chemistry and materials science.