FICHE DE POSTE

PhD position, Project TITANIDE

3D arrays of sol-gel TiO 2 Mie resonators, elaboration and exploration of optical performances

- **General informations**

Length : 36 months
Starting date : 10/2018
Working time : Full time
Salary : 21 222.6 euros/year (gross salary)
Diploma : Master Degree

- **Task**

Mie Resonators (MRs) based on dielectric materials represent an extremely young and promising research topic, with huge applicative potentials in photonics and optics. Based on arrays of sub-micrometric particles that are capable of efficient light manipulation at visible and near-infrared frequencies, these optical systems offer convenient and miniaturised alternatives to complex ones, such as Bragg mirrors, anti-reflection coatings, lenses, controlled light extraction, or graded-index tapered nanostructures for instance. This unique ability to manipulate light is due to a strong modification of the local density of optical states that is favoured with sub-micrometric objects of high dielectric constant materials. Initial studies of the past few years concentrated on Si (silicon) systems, and have shown that MRs could outperform plasmonic nanoparticles. However, the strong optical losses associated with silicon's high absorption coefficient significantly limit their potential applicability. Furthermore, nanofabrication of Si-based MRs relies on specific top-down fabrication technologies, which are impossible to scale-up at affordable prices, and which are not adapted to prepare 3D systems. **TITANIDE proposes to address both of these drawbacks by developing methods to elaborate dielectric oxide (TiO_2) Mie resonators in 2D and 3D architectures through a delicate combination between sol-gel chemistry and soft-Nano-Imprint Lithography (soft-NIL) processing. It will be completed by the detailed investigations of the associated optical properties and functionalities and by their implementation in selected domains of application.**

- **Activities**

TITANIDE is organised in 3 tasks that address fundamental, experimental, technological, and applied aspects; and that will be successful if a strong collaboration between materials chemists, experts in micro-/nano-fabrication, and spectroscopy is established. The work plan is briefly exposed below. Tasks are interdependent and requires that they run more or less in parallel

- Task 1 is dedicated to the development of a unique piece of equipment that couples a confocal spectroscopic microscope and a controlled-environment Soft-NIL bench (confocal spectrometer/optical microscope for far-field characterisation; Design and development of the sol-gel soft-NIL bench)
- Task 2 focalises on the elaboration of the TiO_2 MRs 2D and 3D architectures on arbitrary substrates (e.g. glass, semiconductor, metal, plastic, etc.) from soft-NIL process applied to Sol-gel chemistry of Titania
- Task 3 addresses the implementations of the 3D TiO_2 MR arrays for applications in light global: light extraction, light emission, gas detection, and smart optical functions.

- **Expertise**
  - **Knowledge**
    - Solid-state physics
    - Spectroscopy
    - Material science
    - Chemistry, sol-gel
    - English: good written and spoken
    - Operating systems Windows. Programs: Matlab, Origin, Igor, Lab-view
  - **Operating expertise**
    - Nano-fabrication, Nano-imprint lithography
    - Confocal microscopy and spectroscopy

- **Working environment**
  - **Working place**: NOVA team (chemistry lab., clean room, spectroscopy lab.)

- **To apply**

Please send before 31/07/2018 CV, motivation letter and **candidate-blind** recommendations letters from previous advisors to Marco Abbarchi: marco.abbarchi@im2np.fr ; David Grosso: david.grosso@im2np.fr