PhD FUNDING – GROSS INCOME 2100 € per month

3 years - Starting date: October 2024, 1st

NANTES UNIVERSITY - FRANCE

MOLECULAR PHOTOACTUATORS AT THE NANOSCALE

Context. Transforming light energy into molecular motion represents a fascinated field that Nature wonderfully addresses in the vision and nyctinasty processes. Mimicking such energy conversion with adapted molecules and organic materials currently represents a buoyant topic, finding pervasive use as light-activatable valves, connectors, drug-containing patches, mechanical sensors or surface adhesives.[1]

Research studies. Our approach will deal with the manufacturing and studies of photoelastic amorphous or crystalline materials, amenable to reversibly respond to light by melting, contracting/expanding, or orienting (Figure 1).[2] Photochromic molecules, well-known in eye ware to adapt to outdoor lighting, will be targeted. They will incorporate liquid crystal moieties or long alkyl chains to facilitate cooperative motions after light-induced geometrical changes and get amplified motions. Specific optical setups equipped with various unpolarized and polarized light sources and coupled to mechanical measurements will be used to probe *in situ* the material deformation and quantify the rheological properties (viscosity, elasticity, stiffness). Such coupling at the nanoscale will require high control of the interfaces and operating conditions to provide reliable analyses that are very delicate when nano-objects are to be investigated. Additionally, usual material surface characterizations (zetametry, electron microscopy, UV-vis-IR spectroscopy) will be performed to assess the modifications in the intermolecular interactions. The resulting materials will find applications in acoustic imaging and modulation in the organization of magnetic and optical nanoparticles for data storage.

Profile. All studies will be performed in tight collaboration between two research units CEISAM – UMR CNRS 6230 and IMN – UMR CNRS 6502 at Nantes University France, acquainted with strong expertise in photochemistry and mechanical investigations at the nanoscale.[3] They will bring to the candidate the ability to work in a very stimulating scientific atmosphere embracing energy and biology challenges, at the crossroad of molecular synthesis, photosciences, (nano)materials science and nanomechanics. The recruited candidate is thus expected to possess a strong working-together spirit, be open-minded and ready for interdisciplinarity, and have solid background in functional organic materials and/or physical chemistry.

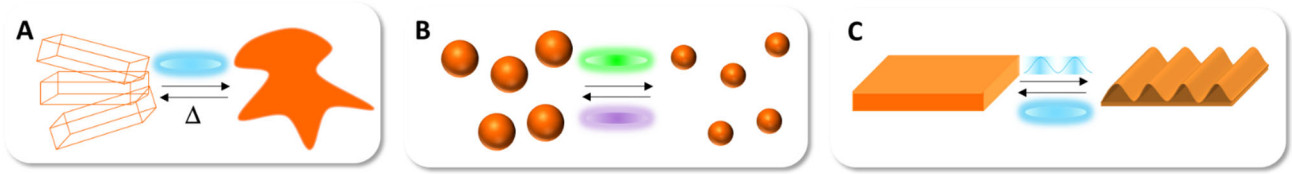

Figure 1. *Photoinduced matter displacement. A) Crystal-liquid transition under homogenous illumination. B) "Breathing" nanoparticles under dual color excitation. B) Sub-micrometer-high reliefs of thin films under structured illumination.*

Contact: Eléna Ishow / Stéphane Cuénot

Nantes University / France - Faculty of Sciences and Techniques CEISAM & IMN

E-mail : elena.ishow@univ-nantes.fr / stephane.cuenot@cnrs-imn.fr

https://ceisam.univ-nantes.fr / https://www.cnrs-imn.fr

Application will first proceed by e-mail by sending a detailed CV, at least one letter of recommendation and final marks in the bachelor and master grades.

Keywords: photochemistry, organic materials, nanoscience, motions, nanomechanics.

References.

1. a) T. J. White, *Photomechanical Materials, Composites, and Systems. Wireless Transduction of Light into Work*, John Wiley & Sons, Hoboken, NJ **2017**. b) V. Y. Chang, et al., *Adv. Opt. Mater.* **2019**, *7*, 1900091. c) J. Boelke et al., *Adv. Opt. Mater.* **2019**, *7*, 1900404.
2. a) K. Imato et al., *Polym. J.* **2024**, *56*, 269. b) P. Naumov et al., *Chem. Rev.* **2015**, *115*, 12440.
3. a) J. Boucard et al., ACS Appl. Mater. Int. **2019**, 11, 32808. b) S. Hoang et al., *ChemPhysChem* **2020**, *21*, 2502. c) F. Rodriguez et al., *Adv. Opt. Mater.* **2021**, *9*, 2100525. d) T. Gallavardin, *J. Phys. Chem. C* **2021**, *125*, 4665. d) S. Cuenot, *J. Mech. Behav. Biomed. Mater.* **2022**, *133*, 105343. e) E. Bequet et al. *Small* **2024**, doi 10.1002/smll.202403912, in press.