**PhD FUNDING**

**Monthly gross income: 2300 €***

**36 months – Deadline to take up the position: December 2026, 1st**

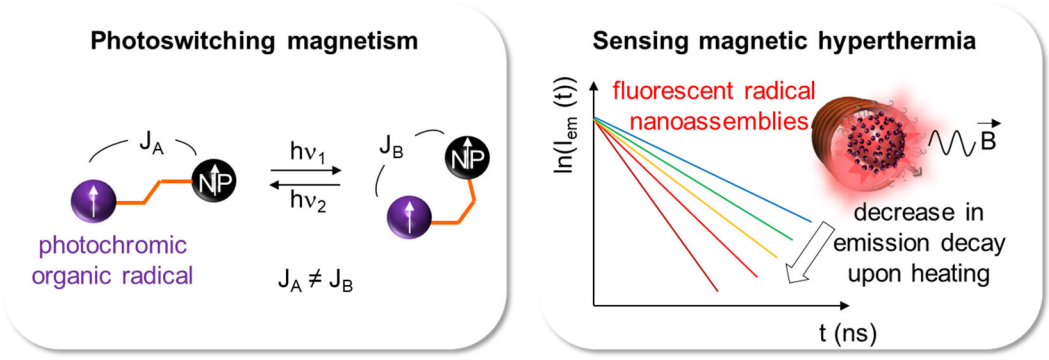
**CEISAM - UMR CNRS 6230 / NANTES UNIVERSITY - FRANCE**

# PHOTOACTIVE ORGANIC RADICALS FOR PHOTOSWITCHING AND SENSING MAGNETIC HYPERTHERMIA

**Keywords**: molecular engineering, photoactive molecules, hybrid nanomaterials, photochemistry and photophysics, magnetism, hyperthermia.

**Context.** Magnetic hyperthermia has appeared as a particularly attractive tool in nanomedicine for on-command drug delivery and activation of heat-triggered processes to fight against diseases. It involves magnetic nanoparticles that generate heat due to energy losses upon periodic alignment along an applied alternating magnetic field. Although numerous nano-objects have been manufactured up to now, the spatial diffusion and time kinetics of the released heat still remain unclear, which requires adapted probes. In this respect, photoactive π-conjugated organic systems display the great advantages to sense or vary the nanoparticle's magnetic moment by exploiting the large sensitivity of their excited state to specific electronic and thermal surroundings. We will thus investigate how light could impact the magnetic properties at short ns and sub-ns timescales and conversely how magnetic switching could influence the dynamics of photoexcited states, which would bring considerable progress in the design of performing materials. The carried studies could present perspectives in the field of spin-based information encoding.

**Research studies.** The multiple goal of the planned researches will be to design, elaborate and investigate hybrid nanoassemblies, composed of organic radicals, endowed with photoactive units (fluorescent, photochromic), and strong affinity toward superparamagnetic iron oxide nanoparticles. Particular attention will be paid to retention and reproducibility of the properties after self-assembly, which will require precise molecular engineering as well as size control of the nano-objects by resorting to microfluidic synthesis, allowing for additional post-processing like surface functionalization. This work will be carried out in the framework of interdisciplinary projects, funded by the French Research National Agency (ANR), addressing high-level challenges in light-matter interactions. It will involve strong collaborations with chemists at Sorbonne University (PHENIX), photophysicists at ENS Paris, physicists at Strasbourg University (IPCMS) and theoreticians at Perpignan University (PROMES), respectively experts in nanomagnetism and magnetic nanoparticles, ultrafast spectroscopic studies, ultrafast spin dynamics and theory of heat and optical coupling in magnetic nanoparticles and nanoassemblies.




**Skills.** The recruited candidate is thus expected to possess a strong working-together spirit, be open-minded and ready for interdisciplinarity, and finally have a solid background **in organic synthesis and molecular physical chemistry.** Other expertise will NOT be examined.

*Tuition fees, including social security, amount to~ 510 € per year.

**Locations.** Our team is more specialist in the design, manufacturing and studies of photoresponsive molecules and nanoassemblies. The lab is equipped with all common organic synthesis facilities and photophysical setups (steady-state and time-resolved absorption and emission spectroscopies, fluorescence microscopy) and has straightforward access to nanomaterial characterizations (TEM, AFM, DLS, zetametry). The candidate will work in a very dynamic scientific atmosphere, embracing energy and biology challenges, at the crossroad of molecular synthesis, photosciences, (nano)materials science and magnetism.

**Contact: Prof. Eléna Ishow**
*Nantes University / France - Faculty of Sciences and Techniques - CEISAM UMR CNRS 6230*
*E-mail : elena.ishow@univ-nantes.fr*
*https://ceisam.univ-nantes.fr*
**Application will first proceed by e-mail by sending a detailed CV, bachelor and master final marks, and recommendation letters, or by default contact names.**

**References**.
F. Zizzi et al, *ACS Appl. Nano Mater.* **2025**, *8,* 24412; E. Bequet et al., *Small* **2024**, 20, 2403912; J. Boucard et al., ACS Appl. Mater. Int. 2019, 11, 32808; F. Rodriguez et al., *Adv. Opt. Mater.* **2021**, *9*, 2100525; T. Briolay et al., *Int. J. Nanomedicine* **2024**, *19*, 633; T. Blondy et al. Nanoscale 2022, 14, 5884; S. Hoang et al., *ChemPhysChem* **2020**, *21*, 2502.

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