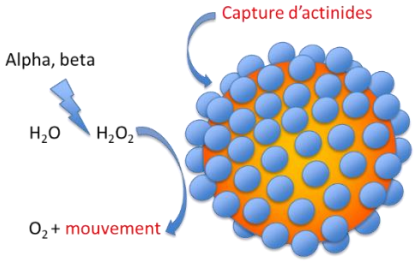
Radiotactic colloids: towards decontamination nanorobots

Context

We propose to develop a new type of active material of colloids capable of moving towards the sources of radioactivity (thus presenting a radiotactism). These colloids will draw their energy from radiolysis products (H_2, H_2O_2) produced in particular by alpha and beta emitter grains. They should therefore trace the H_2O_2 concentration gradients back to their source. They will also make it possible to explore complex geometries (polluted soils, tube assemblies) more efficiently than current methods for extracting contaminants.



Mission

The PhD student will focus on hard colloids taking into account the experience of our partner (BIAM-CEA Cadarache) in the field of active magnetic particles [1], and our laboratory in surface functionalization of immobilized nanoparticles and enzymes [2]. In a first step, she/he will synthesize nanorobots based on different formulations available in the laboratory. These active colloids will be characterized by SAXS and DLS. The main observable in this case will be the measurement of diffusion coefficients in model porous media or the ability to escape from 3D printed labyrinths with hydrogen peroxide gradients. In a second step, the nanorobots will be tested with sources simulating localized irradiation (X-ray or ion sources) before being tested on alphas sources. Once these steps have been successfully completed, we will introduce active colloids with extraction functions [3] on the surface, based on the chelating proteins developed at BIAM [4], thus constituting true autonomous decontamination nanobots.

[1] NanoLett.2013, 13, 5373− 5378; Phys. Rev. Applied 11, 034039 (2019)
[2] Langmuir 2013, 29, 44, 13465-13472; Langmuir 2017, 33, 13, 3241-3252
[3] Self-propelled droplets for extracting rare earth metal ions, doi: 10.1039/c4sm01001a
[4] Chem. Eur. J. 2017, 23, 15505. doi : 10.1002/chem.201703484

Profile

We look for autonomous open-minded and curious candidates from a wide range of backgrounds. Applicants could be graduated from an engineer school or could have a Master degree in Physics/Chemistry/Biophysics or related disciplines and will be motivated by challenges in a multidisciplinary team.
Applicants will have an experimentalist profile.
Applicants shall speak English or French, and have good communication skills.

Duration: 36 months
Starting date: October 2020
Localization: LIONS at CEA Saclay, Gif sur Yvette France.

Contacts

CV, motivation letter and recommendation letter should be sent to both contacts.

Dr Florent Malloggi : florent.malloggi@cea.fr
Dr Jean-Philippe Renault: jean-philippe.renault@cea.fr
Dr Fabienne Testard : fabienne.testard@cea.fr