Hematite microswimmers with enhanced photoactivity

2 Master Thesis projects

Research Group: 1 MEP: Ruud van Ommen, Chemical Engineering TU Delft
1 MEP: Laura Rossi, Chemical Engineering TU Delft

Hematite has been successfully used to engineer colloidal model systems of photo-activated microswimmers [1,2]. The propulsion mechanism of this new class of active particles exploits the photocatalytic proprieties of hematite to create local chemical gradients from the decomposition of a chemical fuel. Hematite particles are in line to becoming excellent candidates as model active particles. This is because, in addition to their interesting active properties, they can be prepared in bulk, they are cheap, biocompatible and can be steered with applied magnetic fields. One disadvantage is that the particles are slow in comparison with other currently available systems. To solve this problem we can think of doping the hematite with materials that can enhance its photocatalytic properties. Preliminary studies (see Figure 1) seem to indicate that hematite particles can indeed swim faster when gold nanoparticles are deposited on their surface.

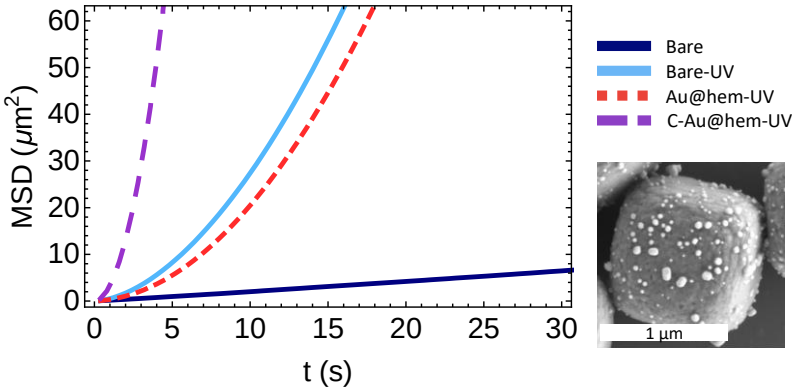

Figure 1 *Mean square displacement (MSD) of hematite particles in the presence of UV-light in different conditions*

In this project the students will investigate in great how the deposition of gold, platinum and palladium nanoparticles on the hematite microparticles can affect their photocatalytic activity. For the nanoparticle deposition one student will focus on wet-chemistry processes, while the other student will use atomic layer deposition.
The student will perform experiments in the lab, synthesis or ALD, as well as microscopy visualization and image analysis. Prior experience with Phython is preferred.

If your are interested, please contact Laura Rossi L.Rossi@tudelft.nl or Ruud van Ommen J.R.vanOmmen@tudelft.nl

[1] J. Palacci, S. Sacanna, A.P. Steinberg, D.J. Pine and P.M. Chaikin, *Science*, *339*(6122), 936–940, 2013.
[2] J. Palacci, S. Sacanna, S.H. Kim, G.R. Yi, D.J. Pine and P.M. Chaikin, *Phil. Trans. R. Soc. A*, *372*(2029), 20130372, 2014.