Synthetic nanomotors

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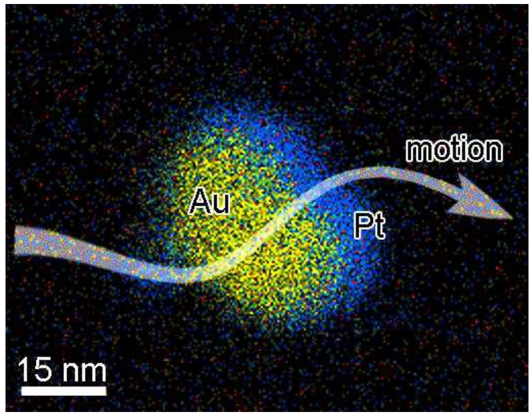

A small number of synthetic particles and microorganisms, and even catalytically active molecules[1] have the ability to undergo self-propulsion. Synthetic materials, which show motion in the presence of a fuel, can serve as a model system for motile biological organisms and show potential for the development of micro- and nano-robots. Self-propulsion can be made directional when external gradients are imposed on the particles.[2] In particular, when the external gradient is chemical in origin this process is referred to as chemotaxis. The chemotaxis of microorganisms or particles towards higher concentrations of chemical stimulus can be against conventional diffusive flow. Chemotaxis is the key method employed by nature to target inflammation, to deliver cargo to effected sites and to locate pathogens. For a synthetic approach to result in directional movement the particle must be anisotropic/Janus-like, which is a significant synthetic challenge. Being able to harness motion at the nanoscale in synthetic systems has great potential as it can be used to deliver a cargo or move nanoparticles to a specific chemical target. Such motion has so far not been implemented with biocompatible reactions and fuels. Here, we propose a joint research effort that aims to realize the first biologically-compatible synthetic nanoparticles that are chemically-propelled. Recently, small nano-sized motors have been synthesized by the **Fischer** group, resulting in 30 nm anisotropic Janus nanoparticles with different metals on each face.[3] The **Stellacci** group recently established a method to create nano-sized Janus nanoparticles.[4,5] These Janus-NPs have an anisotropic surface ligand coating, allowing each face to be functionalized independently from one another. The work in this proposal will look to capitalize on the work of both groups by combining the structurally Janus NPs and analytical techniques of the Fischer group with the surface ligand Janus NPs and gradient generation of the Stellacci group. Such a combination (unique worldwide) will not only allow for current work in each group to be developed but also generate new world leading results.

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[3] T-C. Lee, M. Alarcón-Correa, C. Miksch, K. Hahn, J. G. Gibbs and P. Fischer, Nano Lett. 2014, 14, 2407-2412.
[4] H. Kim, R. P. Carney, J. Reguera, Q. K. Ong, X. Liu and F. Stellacci, Adv. Mater., 2012, 24, 28, 3857-3863.
[5] J. Reguera, H. Kim and F. Stellacci, CHIMIA, 2013, 67, 11, 811-818.