MPIDS Colloquium

MAX-PLANCK-GESELLSCHAFT

Moving Fluids with Light

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The controlled transport of chemical species in fluidic environments has been key to the evolution of life on Earth. Emulating natural structures and processes in the fluid environment has been the subject of extensive research over the last twenty five years either at the nano- or micro- scale. Predominant in this area has been the study of active liquid droplets, which move autonomously or by way of an external stimulus. Such droplets can resemble living systems and have the potential to perform a range of dynamic functions such as material transport, chemical reactivity, signalling and so on. A wide range of stimuli such as chemical, thermal, optical, electrical and mechanical have been used, but the use of light is particularly attractive since it is contactless, can be easily controlled in both space and time and is tuneable.

The simplest approach to the development of artificial motile vesicles has been the use of liquid droplets whose movement is generally the result of changes in surface tension or Marangoni effects. This was first achieved using light as a stimulus by means of the thermocapillary effect in which heating of the droplet by a laser induced Marangoni flows and droplet motion. Following this, the chromocapillary effect was demonstrated, the first light induced Marangoni flow that was isothermal causing droplet movement. This resulted from a photoisomerisation of a photoactive species in the medium surrounding the droplet, rather than in the droplet itself.

We have developed a new approach to isothermal light-induced fluid movement in which the photoactive material is contained within the droplet or fluid itself, rather than the surrounding medium. This allows controlled movement of droplets in three dimensions (3D) using simple light sources as well the movement of fluids in capillaries or larger tubes.

In this presentation, we will describe how both lipophilic and lipophobic droplets can be “pushed” or “pulled” by light in 3D, are able to carry “cargo”, undertake sequential chemical reactions through the interaction of two or more droplets, and be used for a variety of other applications. We will also discuss how the same principles of movement can be utilized to move fluid in capillaries.

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MPIDS, Seminar room 0.77, Am Faßberg 17, Göttingen

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