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pH-dependent motion of self-propelled droplets due to Marangoni effect

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Abstract

Controlling of droplet motion has great promise for diverse potential applications, ranging from target drug delivery to environmental remediation. Such flow can be created by several ways including the thermal, electrostatic, electrochemical, optical, and chemical methods. Among them, the chemical methods can induce droplet motion without any external forces and control its motion with stimulus-responsive functions. Moreover, nano/micro synthetic solid objects have been developed on the basis of combing the concepts of autonomous chemical power generation and asymmetrical catalytic reaction over the past decade. Therefore, chemical methods are considered to be most preferable method in the development of self-propelled objects for accomplishing particular tasks in microscopic spaces beyond the control of external forces.

In this study, we show the pH-dependent motion of the oil droplets loaded with di(2-ethylhexyl) phosphoric acid (DEHPA) in the size of the droplets from 500 □m to 1 cm. When the initial value of pH is adjusted such that pH exceeds the threshold at the equilibrium state, the droplets move spontaneously. Thus, the mobility of the droplet can be switched on/off as a function of pH. It was seen that the droplets was independent of the material of the solid substrates because the droplets were not directly in contact with the surface of the substrate. The condition for the onset of this spontaneous motion was verified by comparing the prediction from the linear stability analysis with experiments.

Biography

Takahiko Ban has completed his PhD at the age of 27 years from Nagoya University and postdoctoral studies in Department of Chemical Engineering in Yamagata University and Doshisha University. He moved to Osaka University in 2011 and is currently developing and characterising self-propelled soft matters. He has published more than 25 papers in reputed journals.