# Microfluidic approach to Facilitate Novel Way to Biology and beyond

Jung-uk Shim(j.shim@leeds.ac.uk)
University of Leeds

**Abstract**

Microdroplets provide a well-defined reactor for facilitating chemical and biological processes. In order to carry out multiple-step reactions therein it is required to control the droplet condition after the formation. I will discuss that the chemical condition of droplets can be controlled using the permeability of molecules through a device material; poly(dimethylsiloxane) (PDMS). A PDMS device is fabricated by multi-layer soft lithography, which can store droplets and control water contents, which is used to study the protein crystallization [1]. I will discuss a microfluidic approach to probe the specific activity of protein, expressed by single cells, by simultaneously monitoring the amount of expressed protein and its enzymatic activity [2]. The permeability of the device material can be exploited to deliver hormone-like small molecules to droplets encapsulating cells [3]. And, the capability of producing and storing micron size droplets enables us to detect and characterize single biological molecules, which forms a platform technology for developing a highly sensitive immunoassay [4]. I will discuss the study of atmospherically relevant ice-nucleating particles (INP) via on-chip droplet generation with downstream cooling [5]. A novel microfluidic device will be discussed, which enables us simultaneously observing neural activity of a pair of bilateral neurons [6]. And, I will discuss that double emulsions of water droplets inside radial nematic liquid crystal droplets can be used to form various structures, ranging from linear chains to three-dimensional fractal structures [7].

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**Biography**

SHIM, Jung-Uk
Lecturer
School of Physics and Astronomy
University of Leeds
Leeds, UK