Dimension-Reconfigurable liquid film nanochannel for label-free biosensing

Yanbo Xie*[1]

[1]Northwestern Polytechnical University [Xián] – China

Abstract

Nanofluidics has attracted much attention for its wide applicability in biotechnology, healthcare and diagnosis. Dimensions of nanostructures and surface properties are the predominant factors determining the potential uses of nanofluidic devices. Here we use a thin liquid film as a nanochannel by inserting a gas bubble in a glass capillary, a technique we name "film nanofluidics". The film nanochannel is fundamentally different from the existing nanochannels due to the tunable dimensions at the three-phase interfaces. We found the height of the film nanochannel can be regulated from 10 nm to nearly 1 μm by adjusting the Debye length and wettability, while the length can be tuned independently by applied pressure. The film nanochannel behaves functionally identical to classical solid state nanochannels, as we observed for example by ion concentration polarization, a unique nanofluidic phenomenon. Furthermore, the film nanochannels were used for label-free immunosensing, by principle of wettability change of the solid interface. We found that the optimal sensitivity of the film nanochannel for the biotin-streptavidin reaction is two orders of magnitude higher than for the solid state nanochannel when measured by a change of surface conduction. We found the binding reaction can be measured at an early stage before equilibrium, accelerating the speed of sensing. Besides, the sensing can be operated at a full range of electrolyte concentrations, since both a change of surface conduction at low concentration and wettability at high concentration contribute to the sensitivity. We believe that the film nanochannel represents a new class of nanofluidic devices that is of interest for fundamental studies and also can be widely applied, due to its reconfigurable dimensions, low cost, ease of fabrication and multiphase interfaces.

*Speaker