Microfluidic devices for biophysical studies and engineering applications of motor proteins

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Abstract

Micro/nano fabrication technologies have been prevailed to many research disciplines. Due to the size matching between fabrications and biomaterials, cells and tissues have been targets of researchers in engineering fields. Promising applications are an organ-on-a-chip to reconstitute an *in vivo* function and a single cell analysis chip targeting for pharmaceutical screening and clinical diagnosis. In contrast, although the micro/nano fabrication has already reached to nanometer scale and can be applied to even a single molecule, applications with biomolecules are still limited. Expecting that such an integration will provide a powerful assay platform at molecular level, our group has been focusing on the applicability of microfluidic devices to motor proteins. With chemomechanical and biological functions of motor proteins that have been biophysically studied over a few decades, we take two research directions: one is to construct nanoscale systems that cannot be realized only by top-down micro/nano fabrications, and the other is to propose experimental tools for biophysical studies. As an example for the former approach, I will present a molecular reaction system [1] and a molecular separation system [2] driven by kinesin and dynein motors. For the latter approach, the tug-of-war of microtubules by kinesin and dynein motors will be presented, which mimic a microtubule sliding and intracellular transport by multiple motors *in vivo* [3]. We also propose an on-chip assay to detect tau proteins, which is known as a biomarker for neurodegenerative diseases such as Alzheimer's disease [4]. We have proposed several bioassays that create functional nanoscale systems and contribute to understanding of *in vivo* functions of motor proteins. As an application of micro/nano fluidic devices, we keep exploring how engineering approaches can deepen science at molecular scale.

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