KINESIN-BASED TRANSPORT OF MICROTUBULES IN ENCLOSED MICROFLUIDIC CHANNELS

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In eukaryotic cells, kinesin molecular motors transport intracellular cargo along microtubules. Kinesin motors walk along their 25 nm diameter microtubule tracks, taking one hundred 8 nm steps per second. [1] *In vitro*, kinesin based motility can be observed by immobilizing the motors on a surface and observing the motion of fluorescently labeled microtubules. There is considerable interest in harnessing the microscale transport capabilities of kinesins and microtubules for microscale transport in lab-on-a-chip devices. Microtubule-based movement requires no external power sources and alleviates the need for high hydrostatic pressures in small channel geometries. Lithographically patterned channels have been shown to effectively guide microtubule motion,[2] and the directional of movement can be specified by the geometry of the channels.[3, 4] However, long distance transport in these open channels is hindered by microtubule detachment from the surface. Enclosed channels confine the microtubules, allowing reattachment and preventing microtubules from diffusing away. Using SU8 channels on glass, laminated with Pyralux as a cap, we achieved microtubule transport in capped channels 10 microns wide and 5 microns deep. This is the first report of microtubule-based motility in enclosed channels of this type. Microfluidic delivery of the motors into these channels is one of the main challenges in this work. We have approached this by forming reservoirs on each end of the channels and drawing in solution by capillary action. In current work, we have created channels etched in glass with a glass cap. Because they are transparent and do not autofluoresce, these bonded channels provide a significant improvement, and represent a key enabling technology for creating microfluidic devices using biomolecular motor transport.

Our long term goal is to construct biosensors or biomolecular separation systems driven by kinesins and microtubules. A second requirement toward these design goals is the ability to sort cargo-loaded microtubules at bifurcations in the microfluidic channels. One way to do this is to direct the microtubule to one or the other arm of a bifurcation using electric fields. We have found that in solution microtubules can be manipulated with both electric and dielectric fields. We are currently testing the function of such electrodes in the constrained geometry of our channels.

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References:

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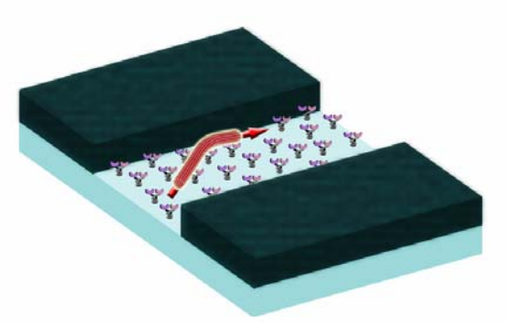

Figure 1: Diagram of kinesin motors transporting microtubules in a microfabricated channel. In current work, we have enclosed these channels to further constrain the movement.

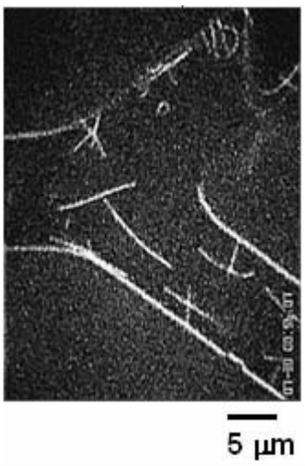

Figure 2: Fluorescent microtubules being transported in a microfabricated channel. Motors (not visible) are immobilized on the surface. Electric fields perpendicular to the channel will guide microtubules to either arm of the bifurcation.