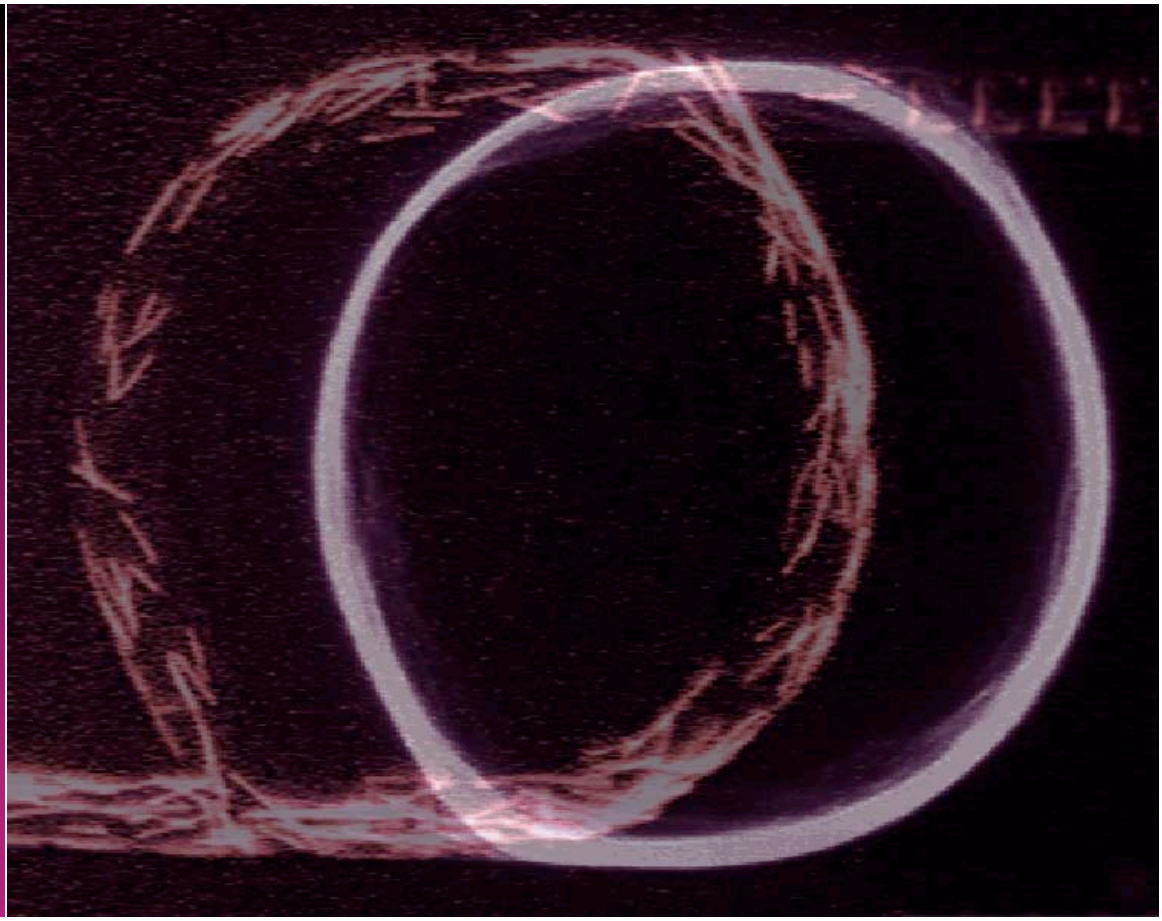
STORAGE RING

Penn State MRSEC

A capped circular channel functionalized with kinesin biomotors loads microtubules from the left and steadily accumulates a large population of circulating fluorescent tubules, as shown by superimposed before and after images.



Microtubules in capped channels
the persistence of circulation

IRG2

In eukaryotic cells, kinesin motor proteins transport intracellular cargo along microtubules, 25nm protein filaments that form the cell cytoskeleton. This biomotor transport system is of fundamental importance in cell function and dysfunction, and provides a model system for nano- and microscale transport in engineered systems. MRSEC researchers Huang, Uppalapati, Hancock, and Jackson are developing techniques to control the direction and concentration of microtubules driven by immobilized kinesin motors to develop an alternative to fluid pumping for microfluidics applications. Gaining control over these subcellular structures will also enable the development of improved experimental systems to study the organization of motors and microtubules that underlies complex cellular process such as cell division.

Recently, we developed a new approach for organizing and aggregating aligned microtubules within a ring structure. Microchannels 4-6 μm wide and 1 μm deep are etched in glass and bonded to a top coverglass to create an enclosed channel. Kinesin motors are immobilized in the channel, and a neighboring reservoir is filled with microtubules in solution. The kinesin biomotors carry the microtubules into the 70 μm ring; tubules that travel counterclockwise continue around the circle, while those traveling in the opposite direction exit the ring after about half a revolution. Over half an hour, hundreds of isopolar microtubules collect in the ring, ready for later deployment as a unidirectional and well-controlled population. This array of co-aligned microtubules is analogous to structures found in cells, and is a significant leap in the control of these subcellular structures.