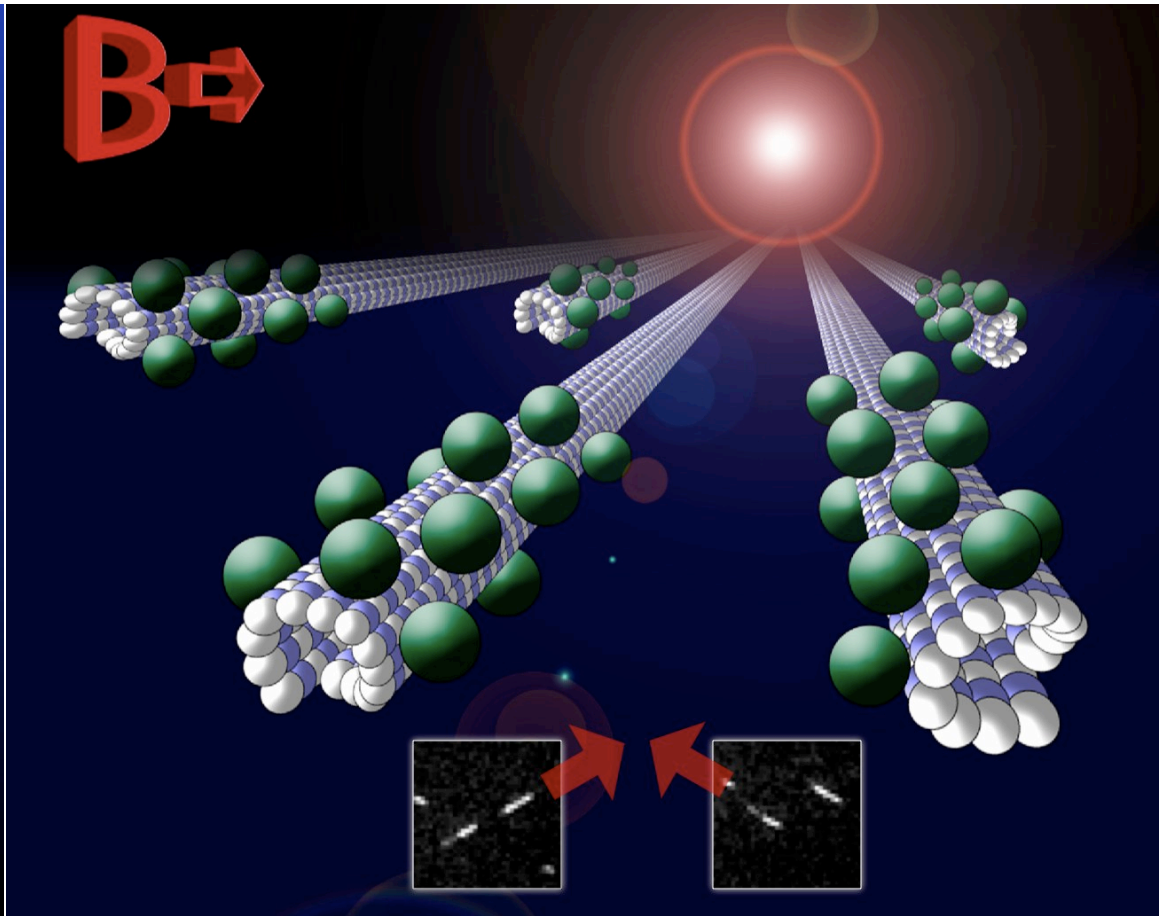
MAGNETIC TUBULES

Penn State MRSEC



Microtubules coated with magnetic beads align themselves along lines of magnetic field. Small **3**, 126 (2007)

Cellular tracks follow the field
special delivery

IRG2

Motor proteins deliver intracellular cargo to specific locations inside cells. These so-called kinesin motors take 8 nm steps along intracellular highways 25 nm wide called microtubules. This transport machinery can be reassembled outside the cell and used to transport nanoscale cargo for separations, sensors, assembly, and other bio-mechanical devices. However, to fully harness these biological motors outside the cell, we need a means both to attach cargo and to lay down the tracks at the desired locations and orientations. MRSEC researchers are using magnetic fields to control the placement and transport of microtubules.

In the reverse of a mobile engine on a stationary railroad track, the biomotor track (the microtubules) is actually mobile while the motors (kinesins) are bound upside-down to the surface, ready to push the microtubule along like a person body surfing at a rock concert. Magnetic nanoparticles of $CoFe_2O_4$ are attached to the microtubules as magnetic "handles." By adjusting the ambient magnetic field, the microtubules can be reoriented, allowing them to be transported in any desired direction.

Even weak magnets can direct the biomotor-driven transport of thousands of microtubules at once. Magnetically labeled microtubules also provide a new tool for investigating the role of microtubules and motors in cellular processes such as cell division, axonal transport, and flagellar motility.

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