Kinesin-based molecular motors for cargo transportation in nanotechnology

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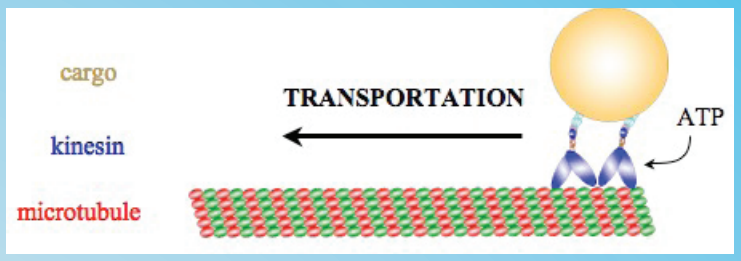
Context

Biomolecular motors, such as kinesin, are highly efficient nanoscale engines that have proven their usefulness in a wide range of biological processes such as motility or intracellular transport [1]. Kinesin convert the chemical energy derived from the hydrolysis of ATP into mechanical work allowing them to move along filamentous tracks called microtubules. The ability to produce and isolate these motors permits the design of hybrid devices, where biomolecular motors serve as force-generating modules in an artificial environment.



Legend: Cargo transportation using biomolecular motors.

Objectives

The potential to use motor protein-driven transport in various nanotechnological applications has been suggested by several authors. This includes for example sorting and unidirectional cargo transportation in a lab-on-a-chip or assembly of molecular components. However, most of these suggestions are rather long-term and no commercially viable product has yet been developed. This represents a real challenge because molecular motors should offer important advantages compared to microfluidics and nanofluidics. Particularly in nanofluidics, pressure-driven transportation becomes increasingly difficult because of the nanometric size of the channel. Motors are not bound by these size limitations and their incorporation into synthetic nanodevices may form the basis for lab-on-a-chip systems of unprecedented miniaturization and complexity.

Methods

We propose to transport oil droplets by using biomolecular motors. The final objective is first to encapsulate nanoparticules or molecules into these small containers. Then, we can bring the droplets into contact and merge them with an electrical field allowing particles (trapped into the droplets) to interact without any liquid manipulation. Direct transportation and electrofusion of oil droplets have been demonstrated [2].

References and Publications

[1] R.D. Vale, Cell, 112, p.467-480.
[2] C. Bottier, M.C. Tarhan, J. Fattaccioli, F.O. Morin, B.J. Kim, and H. Fujita. To appear in Proceedings of MEMS 2008.