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DNA and Depletant Based Control of the Collective Motion of Gliding Microtubules

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ABSTRACT

Motor proteins, like kinesin, transport cargo within biological cells by transforming chemical energy into mechanical energy through the hydrolysis of adenosine triphosphate (ATP). Kinesins walk across small tracks called microtubules. Recent studies have found that these concepts can be applied *in vitro* by attaching the motors to a glass substrate, on which microtubules can then glide across. These systems could be useful for many applications, such as targeted drug delivery and efficient, easy medical diagnosis. However, the motion of traveling microtubules is randomly ordered, and methods for controlling it are often hard to implement and recreate. One promising approach is to use depletants, or unreactive macromolecules, that can align microtubules in the same direction by forcing them to move together. This study aims to improve control of microtubule collective motion by using DNA as a signal to increase the effect that depletants have on the microtubule system. This is done by attaching bulky DNA molecules to the filaments, thus increasing their volumes. By comparing the organization of the system before and after the modification of the microtubules, the effects can be analyzed at many concentrations. This study provides an assessment of the relationship between the use of altered microtubules and the concentration of depletants within a gliding assay to induce an ordered collective motion.

KEYWORDS

Microtubule gliding assay, motor protein, depletion force, DNA, nanotechnology, biotechnology