578e Directionally Guided Actin-Based Particle Motility in Vitro

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Polymerizing actin filaments can be potentially exploited in vitro as a means of particle separation in microdevices by propelling nano- and micro-particles in a directed, non-Brownian fashion. During actin-based motility, particle-bound filament end-tracking motors, such as ActA/VASP and formins, become attached to the (+)-ends of actin filaments, where they use on-filament ATP hydrolysis to facilitate actin monomer addition and to translocated to the polymerizing end of actin filaments. Substrates functionalized with inactivated myosin specifically bind to the sides of actin filaments, confining motility to the plane of the substratum. The polymerizing filaments are bundled by cross-linking proteins to form an “actin tail” and to anchor them to the substratum, thereby providing a thrust point for the particle's forward propulsion. Total internal reflection fluorescence (TIRF) microscopy provides a means for characterizing particle motility by single and multiple filament actin tails at the surface under different polymerization conditions. We have successfully produced motility by covalently coupling Listeria ActA to polystyrene microspheres and adsorbing inactivated myosin to glass surfaces. Actin-based motility of sub-micron particles along these surfaces has been verified by using fluorescently labeled actin to visualize the tail. Surfaces micropatterned with myosin by microcontact printing allow us to direct motility along linear tracks, as indicated by preliminary results showing directional polymerization along these tracks.