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Microscopic Tribotactic Walkers JOSHUA STEIMEL, JUAN ARAGONES, ALFREDO ALEXANDER-KATZ, MIT — The translational motion of a rotating object near a surface is strongly dependent on the friction between the object and the surface. The process of friction is inherently directional and the friction coefficient can be anisotropic even in the absence of a net friction coefficient gradient. This is macroscopically observed in the ordering motif of some animal hair or scales and a microscopic analog can be imagined where the friction coefficient is determined by the strength and density of reversible bonds between a rotating object and the substrate. For high friction coefficients most of the rotational motion is converted into translational motion; conversely for low friction coefficients the object primarily rotates in place. We exploited this property to design and test a new class of motile system that displays tribotaxis, which is the process by which an object detects differences in the local friction coefficient and moves accordingly either to regions of higher or lower friction. These synthetic tribotactic microscopic walkers, composed of a pair of functionalized superparamagnetic beads, detect gradients in the spatial friction coefficient and migrate towards high friction areas when actuated in a random fashion. The effective friction between the walkers and the substrate is controlled by the local density of active receptors in the substrate. The tribotactic walkers also displayed trapping in high friction areas where the density of free receptors is higher.

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