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Beds of reconfigurable angled hairs rectify Stokes flows JOSE ALVARADO, JEAN COMTET, ANETTE PEKO HOSOI, Massachusetts Inst of Tech-MIT — Biological tissues such as intestines, blood vessels, kidneys, and tongues are coated with beds of passive, elongated, hair-like protrusions such as microvilli, hyaluronans, primary cilia, and papillae. Stresses from fluid flows can bend deformable hairs, but this reconfiguration can in turn affect confined fluid flows. We investigate this elastoviscous coupling by developing a biomimetic model system of elastomer hair beds subject to shear-driven Stokes flows in a Taylor-Couette geometry. We characterize this system with a theoretical model which shows that reconfiguration of hair beds is controlled by a single elastoviscous number. Hair bending results in an apparent shear thinning because the hair tip lowers toward the base and thus widens the gap through which fluid flows. When hairs are cantilevered at an angle subnormal to the surface, flow against the grain bends hairs away from the base and thus narrows the gap. Beds of reconfigurable angled hairs can thus give rise to an asymmetric flow impedance at arbitrarily low Reynolds number and could therefore function as a microfluidic rectifier.

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