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Metal-like transport in proteins: A new paradigm for biological electron transfer[1] NIKHIL MALVANKAR, MADELINE VARGAS, MARK TUOMINEN, DEREK LOVLEY, University of Massachusetts, Amherst — Electron flow in biologically proteins generally occurs via tunneling or hopping and the possibility of electron delocalization has long been discounted. Here we report metal-like transport in protein nanofilaments, pili, of bacteria *Geobacter sulfurreducens* that challenges this long-standing belief [1]. Pili exhibit conductivities comparable to synthetic organic metallic nanostructures. The temperature, magnetic field and gate-voltage dependence of pili conductivity is akin to that of quasi-1D disordered metals, suggesting a metal-insulator transition. Magnetoresistance (MR) data provide evidence for quantum interference and weak localization at room temperature, as well as a temperature and field-induced crossover from negative to positive MR. Furthermore, pili can be doped with protons. Structural studies suggest the possibility of molecular pi stacking in pili, causing electron delocalization. Reducing the disorder increases the metallic nature of pili. These electronically functional proteins are a new class of electrically conductive biological proteins that can be used to generate future generation of inexpensive and environmentally-sustainable nanomaterials and nanolectronic devices such as transistors and supercapacitors. [1] Malvankar et al. Nature Nanotechnology, 6, 573-579 (2011)

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