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Direct observation and quantification of extracellular long-range electron flow in anaerobic bacteria[1] NIKHIL MALVANKAR, SIBEL YALCIN, MADELINE VARGAS, MARK TUOMINEN, DEREK LOVLEY, University of Massachusetts, Amherst — Some anaerobic microorganisms are capable of transporting electrons outside their cell to distant electron acceptors such as metals, minerals or partner species. Previous studies have focused primarily on transport over short distances (< 1 μm) via diffusion of molecular intermediates, or alternatively via tunneling or thermally-activated hopping across biomolecules. However, we have found that *Geobacter sulfurreducens* can transport electrons over long distances (> 10 μm) using pili filaments that show organic metal-like conductivity [1]. Pili also enable direct exchange of electrons among syntrophic *Geobacter* co-cultures [2]. In order to establish the physical principles underlying this remarkable electron transport, we have employed a novel scanning probe microscopy-based method to perform quantitative measurements of electron flow at a single cell level under physiological conditions. Using this nanoscopic approach, we have directly observed the propagation and distribution of injected electrons in individual native bacterial extracellular proteins. Our direct measurements demonstrate unambiguously for the first time that the pili of *G. sulfurreducens* are a novel class of electronically functional proteins that can sustain electron flow in a surprising manner that has not been observed previously in any other natural protein.

[1] *Nature Nanotechnology*, 6, 573 (2011)
[2] *Science*, 330, 1413 (2010)

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