Abstract Submitted
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Seeing is believing: Direct imaging of charge flow along pili proteins reveals new mechanism for bacterial electron transfer[1] NIKHIL MALVANKAR, SIBEL EBRU YALCIN, RAMESH ADHIKARI, MARK TUOMINEN, DEREK LOVLEY, University of Massachusetts Amherst — Visualization of charge flow on the nanoscale in proteins is crucial for a fundamental understanding of several life processes. Here, we report direct visualization of charge propagation along native pili of *Geobacter sulfurreducens* at nanometer resolution using electrostatic force microscopy [1]. Surprisingly, charges injected at a single point into individual, untreated pili, still attached to cells, propagate over the entire filament. The charges propagate despite a lack of cytochromes on the pili, in contrast to the dominant biochemical model that proteins are electronically insulating and must incorporate redox-active cofactors in order to achieve electron transport functionality. The mobile charge density in pili is comparable to synthetic organic conductors, increasing with proton doping, and with temperature-dependence consistent with previously discovered metallic-like transport mechanism [2]. Conductive pili enable syntrophic bacteria to share energy by directly exchanging electrons among each other [3]. Measurements along individual pilus using nanoelectrodes showed ohmic behavior strongly dependent on the amino acid composition of pili. Electron transfer rate measurement revealed that the pili conductivity is the decisive factor in controlling the bacterial respiration rate.

[1] *Nature Nano*, AOP (2014)
[2] *Nature Nano*, 6, 573 (2011)
[3] *Science*, 330, 1413 (2010)

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