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Structural basis underlying the metallic-like conductivity of microbial nanowires[1] NIKHIL MALVANKAR, MADELINE VARGAS, MARK TUOMINEN, DEREK LOVLEY, University of Massachusetts, Amherst — Microbial nanowires are electrically conductive proteinaceous pili nanofilaments secreted by *Geobacter sulfurreducens*. In contrast to current biochemical understanding that proteins are insulators, *G. sulfurreducens* pili show organic metallic-like conductivity [1]. Pili also enable direct exchange of electrons among *Geobacter* co-cultures [2]. Site-directed mutagenesis studies revealed that aromatic amino acids confer conductivity to pili [3]. In order to develop a structural understanding of the pili to probe the conduction mechanism at a molecular level, we employed three complementary structural methods – X-ray microdiffraction using synchrotron radiation, rocking curve X-ray diffraction, and electron diffraction. Studies performed with all these three methods revealed a 3.2 Å periodic spacing in wild-type *G. sulfurreducens* pili, expected for metal-like conductivity and a lack of such spacing in genetically modified non-conductive pili. Notably, both the peak intensity and the conductivity increased 100-fold with lowering the pH from pH 10.5 to pH 2, demonstrating a structure-function correlation in pili. We also reconstructed the three dimensional tertiary structure of pili with homology modeling, which further suggested the 3.2 Å spacing among aromatics associated with metal-like conductivity.

[1] *Nature Nanotechnology*, 6, 573 (2011)
[2] *Science*, 330, 1413 (2010)
[3] *mBio* 4:e00105-13 (2013)

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