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RESEARCH

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For current passing Geobacter bacteria need only wafer-thin cell processes, no thick cable, as we humans. (Photo: picture alliance / dpa / Daniel Karmann)

Live wire

Why filamentous appendages of bacteria in the soil, such as cable work

Lucian Haas

Microbiology. - Geobacter are unusual soil bacteria. Your metabolism is working anaerobically, without oxygen. Excess electrons on metals they give off, and even outside of her body. But they have fiber-like cell extensions called pili, which are up to 20 times longer than the bacterium itself The idea that these pili may function similarly to metallic cable, is controversial among biologists for years. U.S. researchers have now presented this new evidence and explanation.

Eight years before Derek Lovley postulated for the first time in the journal "Nature" that the soil bacterium *Geobacter sulfurreducens* about his long filamentous appendages can conduct electrons as through metal. At that time he earned from colleagues disbelief and sheer criticism. And even more in 2011 when he presented data that showed that the so-called pili of bacteria similar electrical characteristics as metal-organic nanowires, hit him continued skepticism. Metal-like conductor in an organism - that seemed hard to imagine for many biologists. The U.S. microbiologist from the University of Massachusetts at Amherst even understands this.

"The concept of a metal-like conductivity know material researchers from synthetic fabrics., But this is the first time that which was found in a biological material. Then, is a new concept, and we need a lot of evidence to ensure that this idea also correctly being. "

Said and done: the magazine mBio Derek Lovley recently delivered not only further evidence, but also the first time an explanation of how amazing the conductivity of the pili is made. The new findings are based on a genetic experiment. Lovley and his colleagues created in the laboratory a new strain of Geobacter bacteria with a small but significant genetic change. They manipulated the design to the proteins that form long chains as the backbone of the pili. They replace some amino acids having an aromatic ring, with non-aromatic amino acids. Thereby did not change the outer shape of the pili.

"Under material researchers, it is known that metal-like conductivity of synthetic organic material, based on the aromatic compounds. On a protein as defined in the pili these aromatic compounds would therefore be aromatic amino acids. We tested this hypothesis by five aromatic amino acids at the rear end of the protein exchanged by non-aromatic amino acids. characterized And the conductivity of the pili has been lost. "

Conversely, it is the proof: There are actually these aromatic amino acids which ensure that the pili are of such a thing as biological nanowires with metal-like properties. Lovley:

"In biology, an electron transfer occurs usually in that the electrons from one molecule to jump to the next. In

a metal-like conductor, the electrons are not but bound specifically to a molecule. It is rather a sea of free electrons in the direction of the electron transport can flow. "

Aromatic amino wear ring structures of carbon molecules. If several of these rings close together, their electron clouds overlap. Excess electrons can flow over large distances then relatively free as in metals. How and where exactly is happening in the pili will clarify Derek Lovley next.

"We need to better understand the structure of the pili. We know that the aromatic amino acids are important, but we do not really know how arrange these amino acids are the building blocks of the pili. Nor yet how these blocks are assembled to the to form long conducting threads. "

In addition to such basics Derek Lovley explored but even practical applications. Because they conduct electricity so good, Geobacter bacteria colonies are ideal for building including microbial fuel cells.