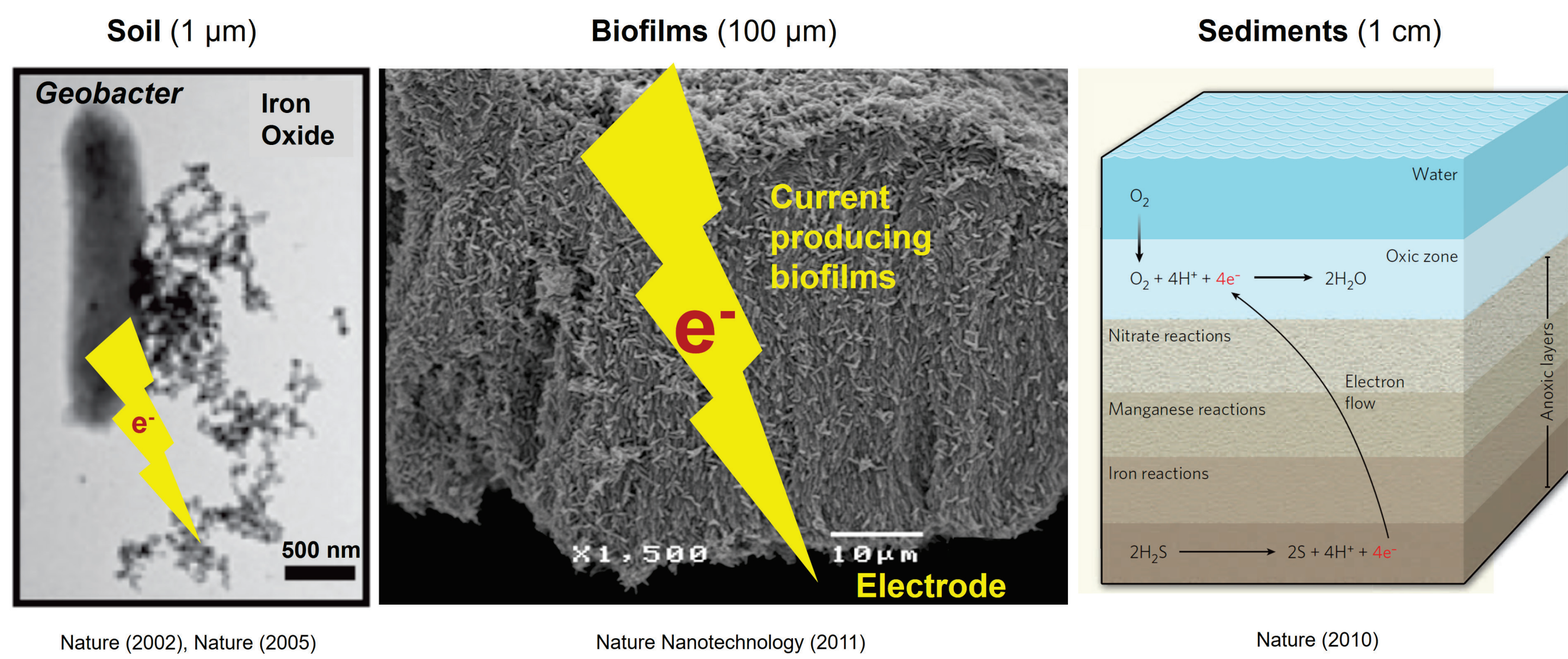


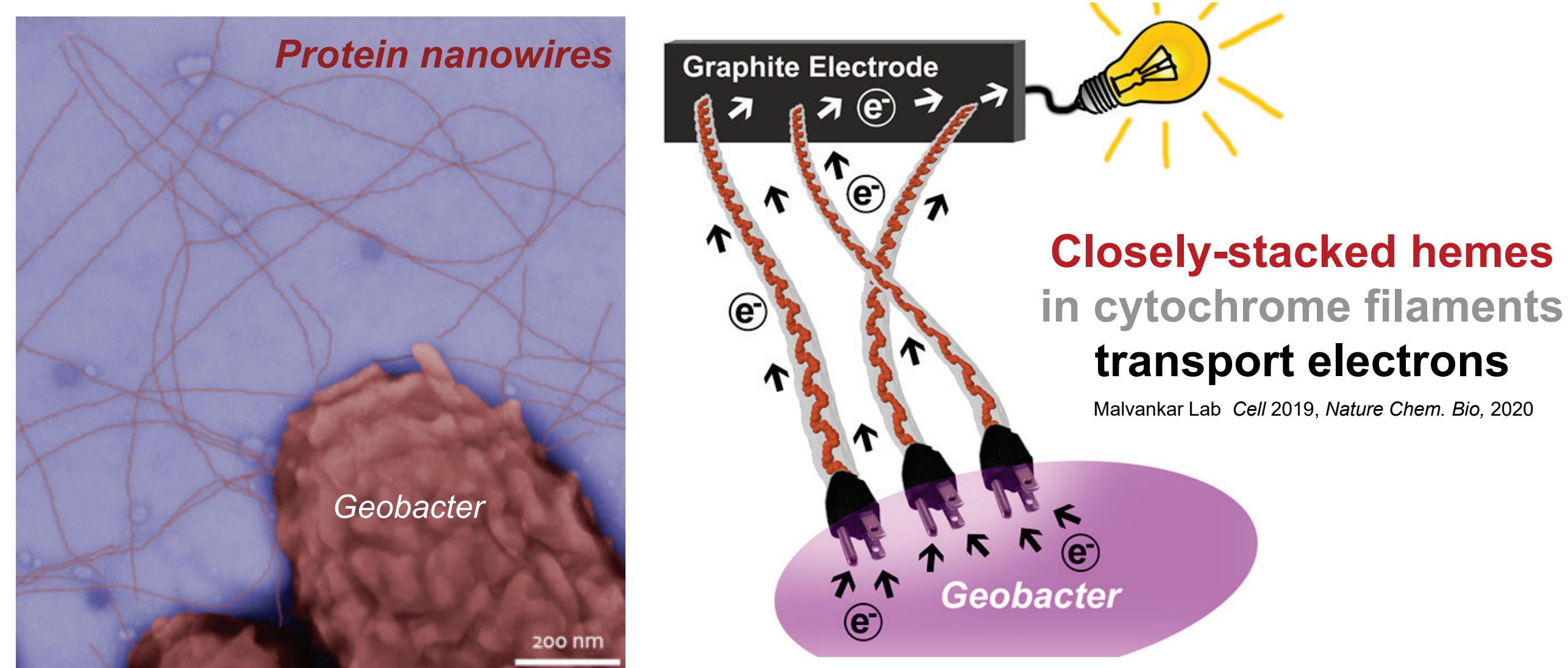
Electronic control of bacterial behavior via protein nanowires

Nikhil Malvankar Asst. Professor of Molecular Biophysics & Biochemistry, Microbial Sciences Institute, Yale

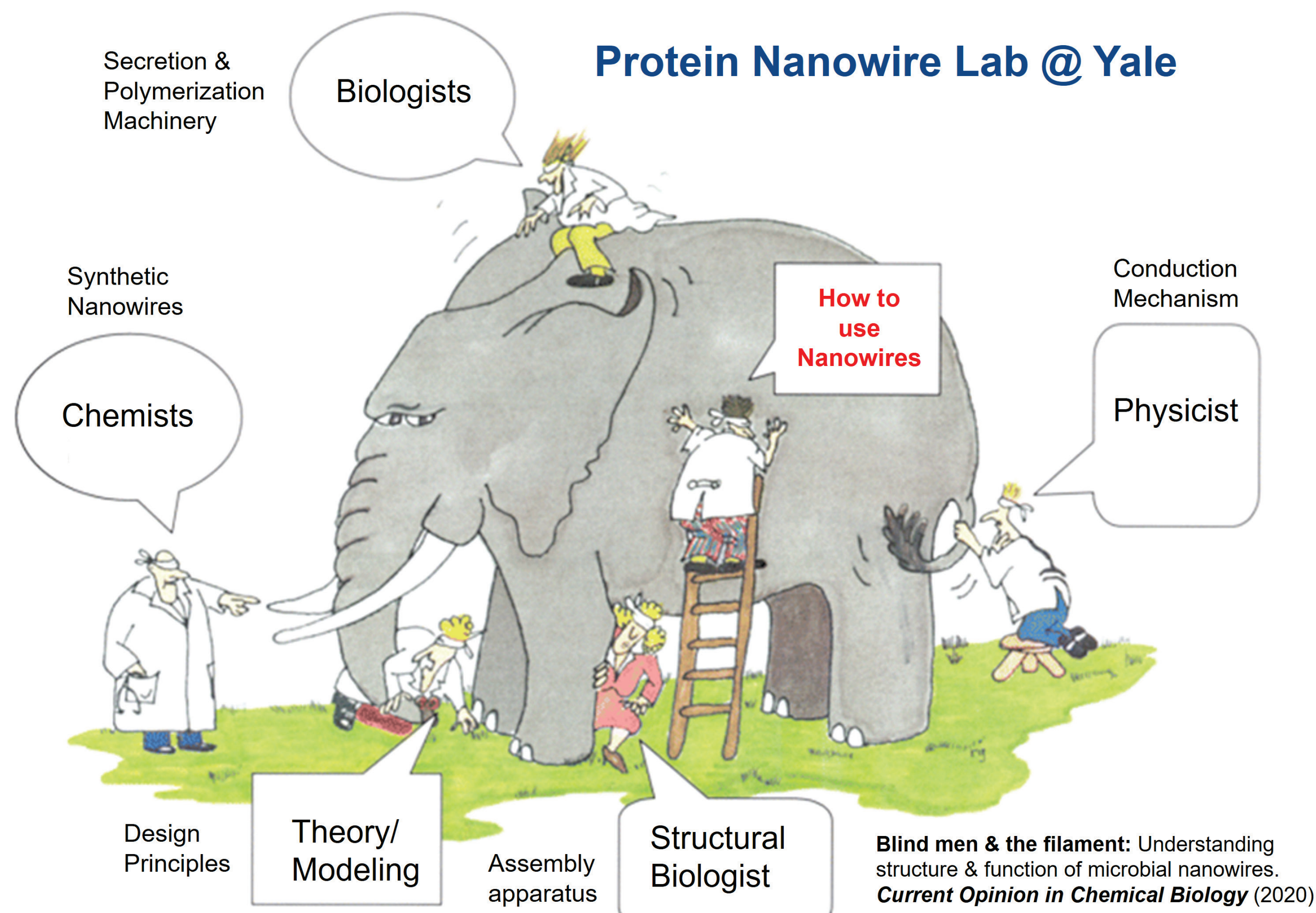
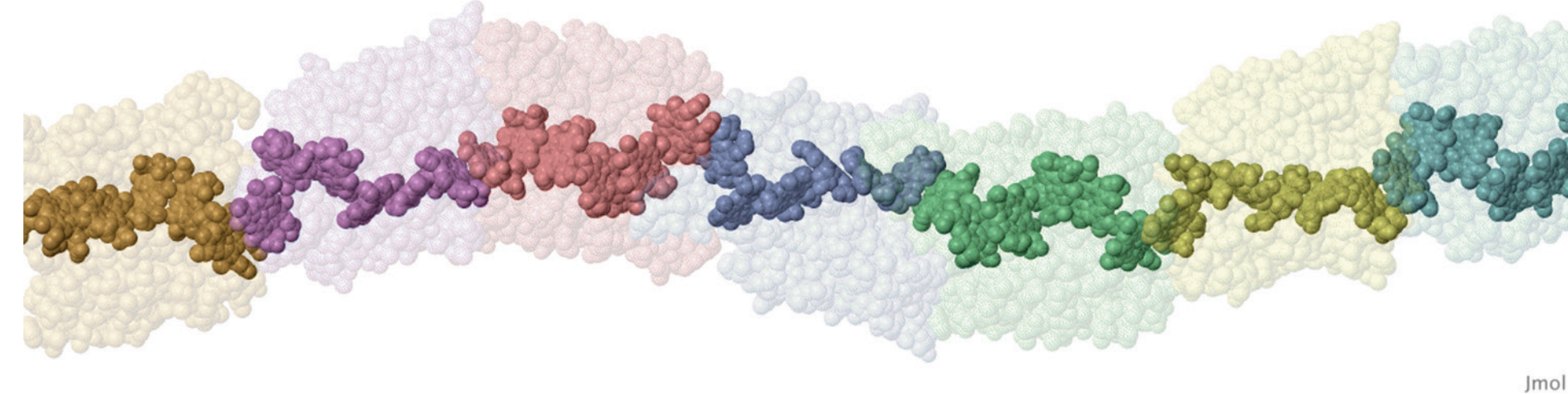
Many environmentally-important bacteria respire by exhaling electrons over 100-10,000 times their size using protein nanowires as a snorkel



We have found that these nanowires are made up of cytochromes



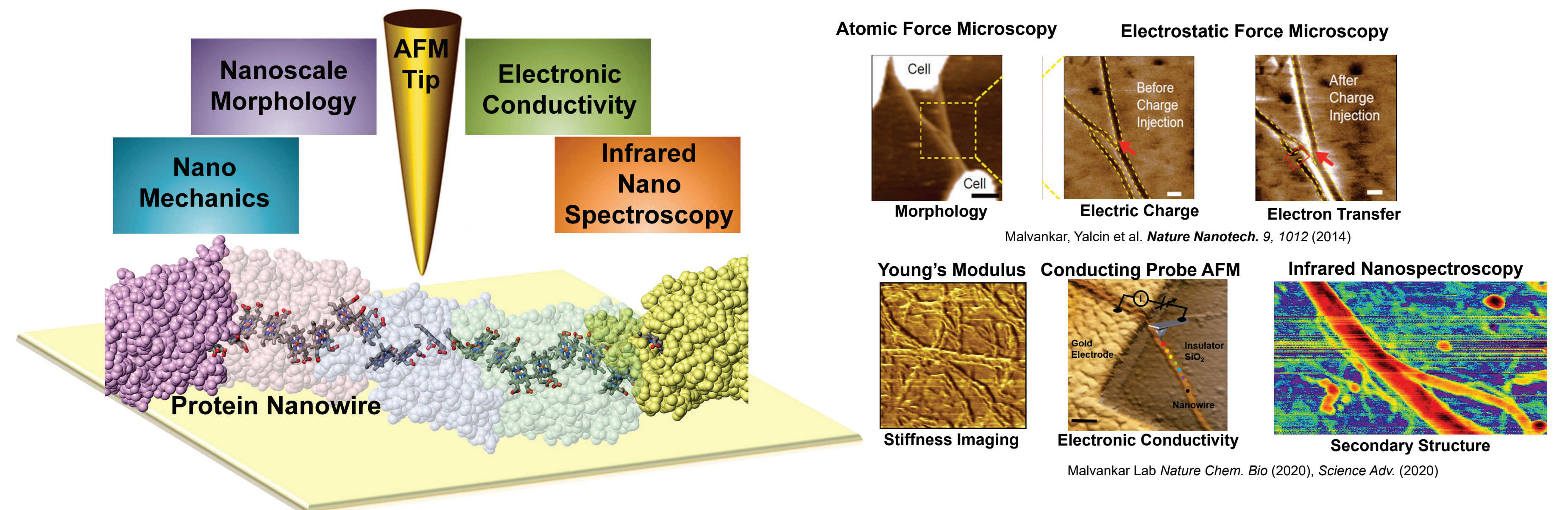
Protein surrounding hemes functions as insulation for nanowires



Three major research themes

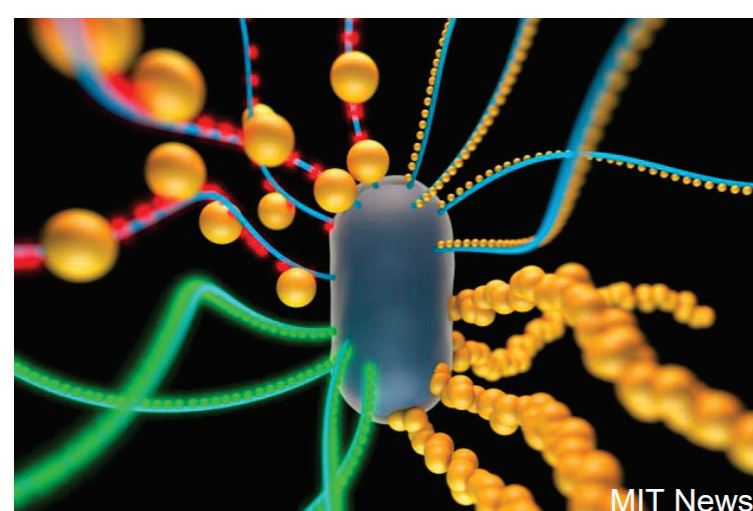
- Nanowire diversity and biological role:** We are finding that nanowires are widespread in diverse bacterial species and are used for a broad range of physiological and ecological functions.
- Assembly machinery:** We are identifying the nanowire assembly machinery using genetic tools combined with x-ray crystallography and cryo-electron microscopy and tomography.
- Conductivity Mechanism:** Existing models of biological electron transfer cannot fully explain such high conductivity in proteins. We are building a new fundamental framework by performing conductivity measurements as a function of several physical and chemical probes.

Multimodal Imaging of Bacterial Electron Transfer with Nanowire Structure and Functions

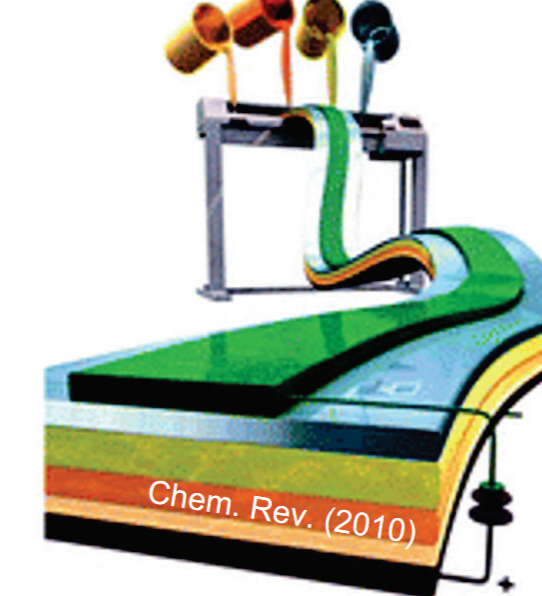


Bacteria-powered Multifunctional Materials and Technologies based on Protein Nanowires

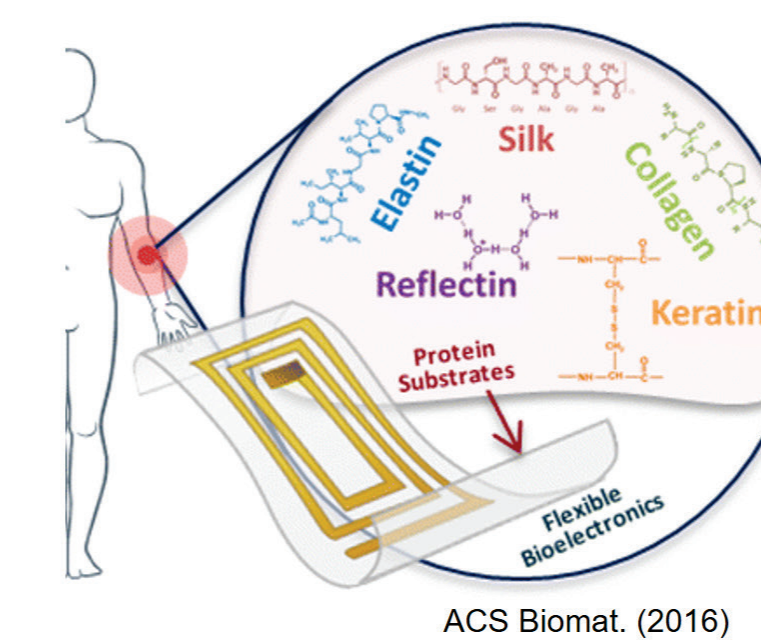
Bacterial Factory
Electronics & Photonics



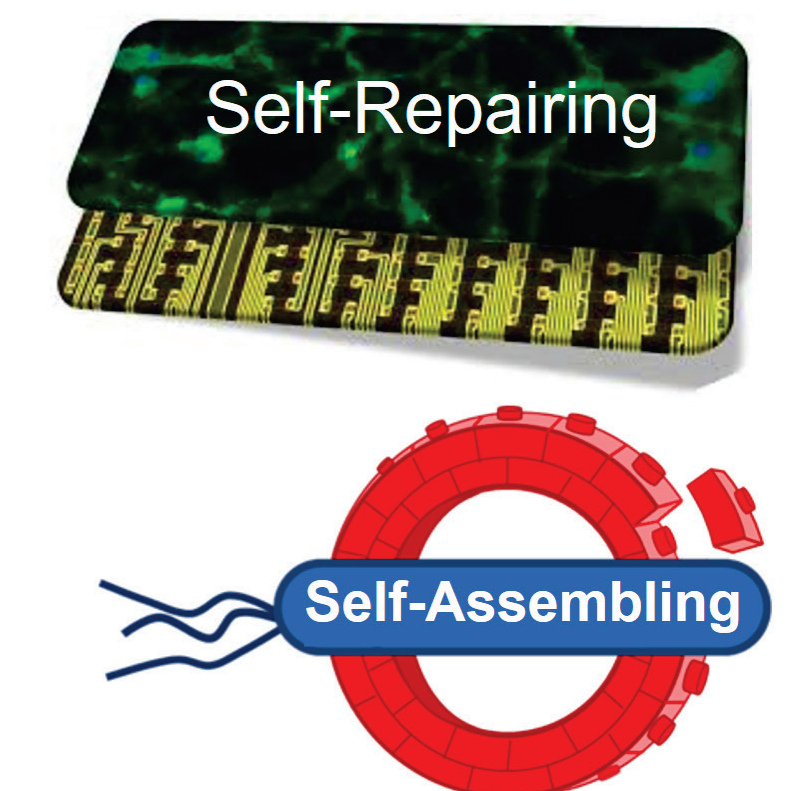
Fast & Scalable Synthesis
5 seconds for 1GB Chip



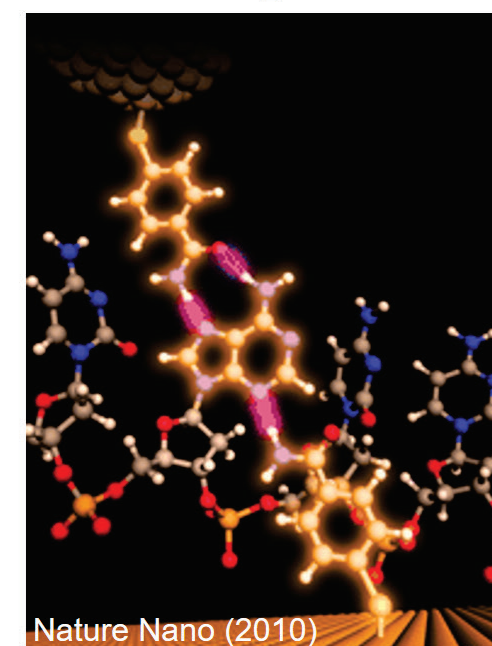
Flexible



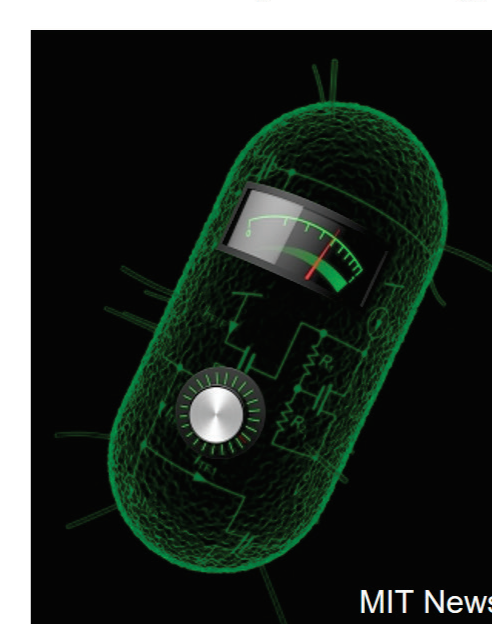
Regenerative Electronics



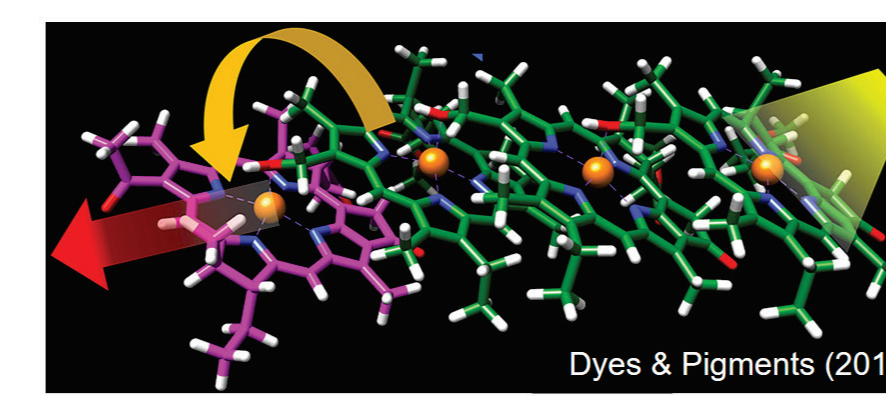
DNA Sequencing



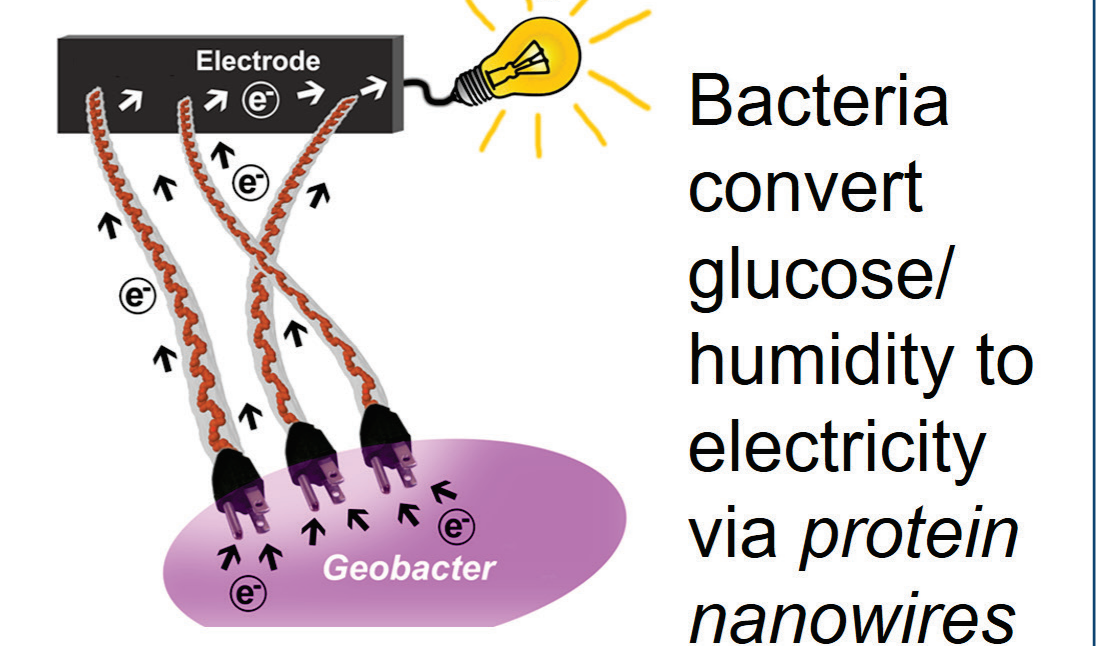
Computing



Light Harvesting



Self-Powered Body Sensors



JOIN US! Our highly interdisciplinary team is solving many mysteries of bacterial nanowires

Yangqi Gu
Vishok Srikanth
Joey Erwin
Fadel Samatey (RS)
Cong Shen
Aldo Salazar Morales
Yuri Londer (RS)

Biochemistry/
Structural
Biology

Molecular
Biology/
Microbiology

**Protein
Nanowires
Lab**

Biophysics
/Chemistry

Theory/
Computation

RS: Research Scientist; PD: Postdoc

Catharine Shipp

Sophia Yi (PD)

Jens Neu (PD)

Sibel E. Yalcin (RS)

Jackie Mendes (Tech)

Peter Dahl, Guna M.

Matthew Pfeffer (PD)



BURROUGHS
WELLCOME
FUND
Career Awards at the
Scientific Interface

NIH DIRECTOR'S
NEW INNOVATOR
AWARD

DARPA
DEFENSE ADVANCED
RESEARCH PROJECTS AGENCY

NSF
CAREER
Award

THE HARTWELL FOUNDATION

Charles H. Hood
FOUNDATION

CRFP
NDSEG
NATIONAL DEFENSE SCIENCE & ENGINEERING GRADUATE FELLOWSHIP

Collaborators:
Victor Batista (Theory)
Gary Brudvig (EPR)
Isaacs (Synthetic Biology)

Please come chat with us to match your interests with our training opportunities. Rotation projects are experimentally or computationally oriented with possibilities of combining both and no background in a specific discipline is necessary.