Proteins as Solid State Electron Transport Materials

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Proteins can be viewed as materials with tunable optoelectronic properties that, via doping, can extend well beyond their biological ones.

The reasons are

-a- the ability, for many proteins, to change their properties by adding/replacing co-factors or external molecular or ionic moieties

and

–b- that proteins are surprisingly good solid-state electronic conductors, even those that have no known biological electron transfer function, more akin to conjugated molecules with extended conjugation than to saturated ones.

What is measured is solid-state electron transport (ETp) across proteins that are "dry" (retain only tightly bound water, to keep native conformation) as function of bias, temperature, pressure, illumination and/or humidity.

Importantly for future bioelectronics, the results are sensitive to protein modification, i.e., adding or removing or altering cofactors, all change ETp.

Such cofactors can thus be viewed as natural dopants for proteins.

We can also transform a biologically totally electrically inactive protein into a very efficient ETp medium by doping it.

Our studies help understand ETp mechanisms and how ETp differs from biological Electron Transfer, ET, which, in turn provides deeper understanding of ET.

(Work done with M. Sheves and I. Pecht).