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Presents

Constructing Electrical Nanodevices From Biological Molecules

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A molecular device fabricated from metallic deoxyribonucleic acid (M-DNA) exhibits a negative differential resistance (NDR) behavior. When two gold electrodes were connected by Ni^{2+}-chelated DNA, which was converted from λ-DNA, not only was the conductivity of DNA improved, but a NDR device was formed as a full cyclic voltage sweep was applied to measure its current versus voltage characteristics at room temperature and in an ambient environment. Such electronic characteristics of a M-DNA device may have been caused by the redox reactions of Ni ions. This finding provides a simple way to construct electrical nanodevices from biological molecules.

Our lab also developed the first protein based molecular magnets and patterning technology on a semiconductors surface. A highly magnetically aligned metallothionein containing Mn and Cd (Mn,Cd-MT-2) is first synthesized, and the molecules are then placed into nanopores prepared on silicon surfaces using electron beam lithography and reactive ion-etching techniques. We have observed the self-assemble growth of the MT molecules on the patterned Si surface such that the MT molecules have grown into rod or ring type three dimensional nanostructures, depending on the patterned nanostructures on the surface. This engineered molecule shows molecular magnetization and is biocompatible with conventional semiconductors. These features make Mn,Cd-MT-2 a good candidate for biological applications and sensing sources of new nanodevices. Using molecular self-assembly and topographical patterning of the semiconductor substrate, we can close the gap between bio-molecules and nanoelectronics built into the semiconductor chip.

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