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Electrical properties of DNA-templated Copper nanowires

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Recent studies on the electrical properties of the modified deoxyribonucleic acid (DNA) molecules. The modified DNA nanowires have many merit to fabricate the nano scale device. Particularly, the modified DNA is able to approach the bottom-up method. Therefore, many researchers have studied about electrical modifying of the DNA molecules. The metallic DNA (*M*-DNA), metallization DNA and DNA-templated nanoparticles are consisted in modified DNA. For example, Some kinds of metal ions, which replace imino proton in DNA helix, such as zinc (Zn^{2+}), cobalt (Co^{2+}), copper (Cu^{2+}) and nickel (Ni^{2+}) are used for incorporation into *M*-DNA.

In this work, we investigated the electrical properties of DNA-templated copper (Cu) nanowires. We successfully prepared the Cu nanowires by the Cu metallization of DNA molecules. To investigate the current-voltage (*I-V*) characteristics of DNA-templated Cu nanowires, we fabricated the two-terminal electrodes which had 20 nm gap size. Then DNA molecules were attached on the nano scale electrode by electrical trapping and suction method. Finally, the $Cu(NO_3)_2$ solution was dropped on DNA molecules and the reducing agent (Boric acid in this experiment) was used to transform Cu divalent metal ions to metallic Cu sheath around the DNA molecules. The Cu^{2+} ions were associated with the DNA molecules by electrostatic force. The *I-V* characteristics of Cu nanowires were measured by semiconductor parameter analyzer at vacuum condition. We prepared various samples that changed the incubation time or the concentration of Cu^{2+} ions to investigate the alternation of *I-V* characteristics. DNA-templated Cu nanowiers have the metallic like electrical properties. This result was proved that the DNA-templated Cu nanower could be fabricated and it would be one of the building blocks for the future nano-scale devices.