NT-P020

Hetero-structural Nanowires Based on DNA-Templated CdS and AuNPs

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Abstract

Nanowire has been researched by many research groups because of its variety of applications such as electronic devices, optoelectronic devices, and many types of sensors. Nanowire is generally synthesized by the bottom up method, because good quality and massive amount of nanowires can be quite easily achieved. However, placing nanowires which are synthesized by the bottom up method on desirable position on the substrate was one of the main problem. DNA could be the solution of this problems because of its self-assembly characteristic and structural feature. DNA is a good participant as a template of nanowires because DNA has a high aspect ratio with the width of 2 nm and length of few nanometer to micrometer and can attach positively charged metal nanoparticles and metal ion on phosphate groups having negatively charge.

In this work, we investigated DNA-templated CdS and gold nanoparticle(AuNP) hetero-structural nanowires. Positively charged gold nanoparticles were attached on phosphate groups of λ-DNA AuNPs were not attached on λ-DNA continuously and formed chain like structures. The empty space of λ-DNA templated AuNPs chains had native λ-DNA. Subsequently, λ-DNA templated AuNPs chains were incubated with aqueous $Cd(NO_3)_2$ solution. Cd ions were seeded on empty space of λ-DNA-templated AuNPs chains' phosphodiester backbone. Subsequent treatment with Na_2S solution to nucleate and grow CdS along the DNA template. We measured topology of these nanowires by FE-SEM and AFM and confirmed CdS was grown along native λ-DNA among AuNPs. We could confirm the formation of DNA-templated CdS and AuNPs hetero-structural nanowires. From these results, these nanowires could be multiple quantum well structure and be used as unique tools for nano-electrical devices in near future.