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Optoelectrical characteristics of single strand of hybrid nanotubes and nanowires using poly (3-methylthiophene)

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Optoelectrical characteristics for a single strand of hybird nanotubes (NTs) and nanowires (NWs) with π-conjugated polymer and metal were studied. Hybrid NTs/NWs had two forms depending on the metal nanostructures; one for coaxial type metal coated onto the polymer NT and another for metal nanoparticles (NPs) adsorbed onto the polymer NT. We used light-emitting poly (3-methylthiophene) (P3MT) as π-conjugated polymer, Ni, Cu, or Au as metal layer for a coaxial nanostructure, and Au NPs. The P3MT and the hybrid NTs/NWs were electrochemically synthesized by using an Al_2O_3 template. The Au NPs with diameter of 3~5 nm were chemically synthesized. The hybrid NTs/NWs were placed onto the SiO_2/Si substrate for optoelectrical characteristics. The Au top contact electrodes on the single strand of the NTs/NWs were fabricated by using E-beam lithography. Optoelectrical characteristics of the single strand of the hybrid NTs/NWs were investigated through a current-voltage (I-V) measurement under light irradiation. Compared with the I-V characteristic curves of the single strand of the P3MT NTs/NWs, the current level of the single strand of the hybrid NTs/NWs clearly increased. The conductance (dI/dV) of the single strand of the hybrid NTs/NWs in low bias region showed the remarkable different characteristics with that of the single strand of the P3MT NTs/NWs, under light irradiation. In addition, temperature dependence of the I-V and the dI/dV for the single strand of the P3MT and hybrid NTs/NWs are compared and analyzed.