DWNT as active electrode in far-IR and THz optical modulation devices

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Far-infrared and terahertz frequencies represent the future of wireless communication systems because of the associated high transmission data rates and low-energy consumption. However, the development of these alternative bands is still in very early stage and there is a need for various efficient components. Because double-walled carbon nanotubes (DWNT) have intense absorption structure that covers both the far-IR and THz regions, they are considered prime candidates as detectors and optical modulators. Absorption modulation of the near-IR and THz bands have been previously observed for single-walled carbon nanotubes (SWNT) by electrostatic and chemical doping.[1,2] However, our recent results suggest that DWNT are more suitable candidates for THz modulation because their far-IR/THz absorption band is at least 2 times higher than that of SWNT for equivalent normalized near-IR intensity. In addition, even if near-IR modulation by electrochemical doping has been previously reported for DWNT,[2] almost no consideration has been paid so far on the modulation of their THz transition.

Here we present results of optical modulation by field-effect and electrochemical doping of both the near-IR and the extended far-IR/THz bands of purified DWNT. Broadband absorption spectroscopy combined with four-point probes resistivity measurements are evaluated at multiple doping levels for different DWNT network densities. Optimization of ON/OFF transmission and modulation frequency is developed for different device configurations.

REFERENCES

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