Photodetectors made of carbon nanowalls transferred on Si and CdTe

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Carbon nanowalls (CNWs) are few-layer graphene nanosheets standing vertically on a substrate. CNWs can be synthesized on various metallic, semiconductor and insulator substrates using various techniques. CNWs demostrate unique structure and special optoelectronic properties, which makes them a promising material for various optoelectronic applications.

In this study, plasma-enhanced chemical vapor deposition (PECVD) is used to synthesis CNWs on copper foil. The surface morphology and quality of the CNWs are analyzed using a scanning electron microscope (SEM) and a Raman spectrometer. The photodetectors were fabricated by transferring the synthesized CNWs films onto Si (n-type) and CdTe substrates. Our simple CNWs/Si and CNWs/CdTe Schottky-junction photodetectors exhibits a high responsivity of 190 mA/W at 950 nm light and 82 mA/W at 710 nm light, respectively. Another important parameter of photodetectors called external quantum efficiency (EQE) is measured from the responsivity of devices. The CNWs/Si photodetector demonstrates the EQE of ~25%. The CNWs/CdTe device exhibits the EQE of 15.7%. The responsivity and EQE can be further improved by changing the bias voltage. The detectivity values of 4.8×10^{11} and 2.1×10^{11} Jones are obtained for the CNWs/Si and CNWs/CdTe, respectively. Because of the high light absorption, the CNWs photodetector based on Si has higher responsivity than the CNWs/CdTe device. The photocurrent of both photodetectors changes with the applied reverse bias and increases with the intensity of incident light. Our study shows that the CNWs is a promising material for high-performance photodetectors.

Acknowledgement

This research was supported by the Nazarbayev University Faculty Development Competitive Research Grant (Grant Number: 110119FD4512), Nazarbayev University Collaborative Research Grant (Grant Number: 021220CRP1922), Young Scientist Grant from the Ministry of Education and Science of the Republic of Kazakhstan (Grant Number: AP08052412).