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Photocurrent measurement in thin-film single-walled carbon nanotube field-effect transistors

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A thin-film single-walled carbon nanotube (SWCNT) has been fabricated as a field-effect transistor (FET) for a photodetector at room temperature. We used suspended SWCNTs in Toluene solution in order to assembly into a micrometer-gap size of Aluminum microelectrodes on SiO2/Si substrate by dielectrophoresis technique. The assembled SWCNTs form a layered SWCNTs network that bridged between the aluminum microelectrodes of up to 120 μm long, acting as a conduction channel of the transistor. We performed photoexcitation measurements of this SWCNT thin film by illuminating Quartz Tungsten Halogen light source with broad wavelengths (λ ˜ 200 - 2500 nm). The measured current was as a result of electron-hole pair creations due to multi-subband energy absorptions of the nanotubes and could be detected by electrical transport measurement up to room temperature. The excited charge carriers in the SWCNTs by increasing light emission power up to 250 W was found linearly dependence of the power, whereas in the individual SWCNT-FET device it shows as a power-law dependence at a given source-drain bias. This linear growth of light intensity was contributed to electron-phonon scattering between bundles of nanotubes and heat dissipation among them. In a comparison with a single conductive FET channel, the measured parallel FET channels exhibit a higher trans-conductance. However, the measured current of both devices shows small increases with light powers when applying gate biases and saturates at a high power. We demonstrated that the carbon nanotube materials can be used for light sensor application or energy harvesting materials for low-power consumption technology. This research can be mostly conducted in Thailand

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