Analysis of Carbon Nanotube Photo-Detectors

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Carbon nanotubes with their direct band-gap have been considered in recent years for future opto-electronic applications. It is particularly intriguing that the band-gap can be tuned with the tube-diameter. We present an analysis of the performance of infra-red photo-detectors based on carbon nanotube field-effect transistors. The established non-equilibrium Green's function formalism is applied for this purpose, and the coupled system of transport and Poisson equation is solved self-consistently. The relatively low ratio of the photo-current to the dark current limits the performance of such devices, as has been experimentally observed. We demonstrate that the dark current can be significantly decreased by employing a double gate structure, whereas the photo- current remains nearly unchanged. The results show that the ratio of the photo- current to the dark-current can be optimized by appropriate selection of the two gate voltages.