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Impact Ionization in Photocurrent Measurements of Carbon Nanotube p-n Junctions NATHANIEL GABOR, Lab of Atomic and Solid State Physics, Cornell University, Z. ZHONG, LASSP, Cornell U., K. BOSNICK, Natl Inst for Nanotech, Natl Research Council of Canada, J. PARK, Chem. and Chem. Biology, Cornell U., P.L. MCEUEN, LASSP, Cornell U. — We investigate the photocurrent response at a nanotube gated p-n junction using a focused laser illumination source. Scanned photocurrent imaging demonstrates that photocurrent response occurs primarily in the p-n junction. Measurements in an optical cryostat down to 4K reveal large photoresponse and unusual step-like structure in the reverse bias photocurrent. We relate the intersection point of the forward bias photocurrent to the flat band condition in the device and infer the band gap, which is in excellent agreement with the band gap determined by thermal activation and diameter measurements. The striking photocurrent steps in reverse bias occur at intervals roughly equal to the band gap. We attribute these steps to impact ionization and carrier multiplication in the junction region of the device. By measuring the photon energy dependence of the impact ionization process, we determine that ionization occurs with high probability for carriers in the second and higher subbands of carbon nanotubes. These results show that nanotube p-n junctions provide an ideal system for probing carrier dynamics and interactions of electrons and holes in nanotubes.

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