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Cryogenically-Cooled, Microwave Bolometer based on Carbon Nanotube Thin Films MICHAEL GASPER, RYAN TOONEN, University of Akron, SAMUEL HIRSCH, MATHEW IVILL, U. S. Army Research Laboratory, HENNING RICHTER, RAMESH SIVARAJAN, Nano-C, Inc. — We have used a carbon nanotube (CNT) thin film fashioned in a Corbino disc test structure to realize a cryogenically-cooled, microwave bolometer. We characterized the noise equivalent power (NEP) down to liquid nitrogen temperatures ($\sim$77 K). The detection mechanism relies on the microwave-power-sensitive resistivity of the CNT thin film. Using lock-in detection, room-temperature experiments (performed with 915 MHz test signals) showed power detection over the range of -45 dBm to 0 dBm–with 0 dBm being limited by the maximum level attainable from available equipment. A sensitivity of 0.36 mV/mW and an NEP of $(3.41\pm0.96)\times10^{-7}$ W/$\sqrt{Hz}$ was achieved with a slightly-cooled device held at a constant temperature of 15°C. Lowering the base temperature of the device resulted in a greater dynamic range–due to the lower NEP. To demonstrate the possibility of using the Corbino effect as a means of tuning impedance matching for optimal performance, cryogenically-cooled magnetoresistance measurements were performed in the presence of a magnetic field (applied normal to the surface of the device) ranging from 0 to 3 T.

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