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Electron Spin Relaxation Dynamics in Single-Walled Carbon Nanotubes[1] WILLIAM RICE, Los Alamos National Laboratory, Los Alamos, NM USA 87545, RALPH WEBER, Bruker BioSpin Corp., Billerica, MA USA 01821, PAVEL NIKOLAEV, SIVARAM AREPALLI, Dept. of Energy Science, Sungkyunkwan University, Suwon 440-746, South Korea, VLADIMIR BURKA, AH-LIM TSAI, University of Texas Medical School, Houston, TX USA 77030, JUNICHIRO KONO, Dept. of Electrical and Computer Engineering, Rice University, Houston, TX 77005 — We have measured temperature-dependent electron spin resonance (ESR) in an ensemble of single-walled carbon nanotubes. From the linewidths of these traces, we clearly observe that the spin-spin dephasing time, T_2, decreases by over a factor of two when temperature, T, is lowered from 300 K to 3 K, a phenomenon we attribute to motional narrowing. We fit the temperature dependence of T_2 with a hopping model and obtain a spin hopping frequency of 285 GHz. At selected temperatures below 100 K, we performed microwave power-dependent scans to investigate the saturation behavior of the ESR signal. A homogenously broadened two-level model fit the saturation data well, which allowed us to extract the spin-lattice relaxation times, T_1, for the investigated temperature range. We observed that the spin-lattice relaxation rate,$1/T_1$, is proportional to T from 100 K to 3 K, suggesting that the relaxation occurs via phonon emission. Last, we show that the Dysonian lineshape asymmetry, which is roughly proportional to the conductivity, follows a three-dimensional variable-range hopping behavior from 3 K to 20 K, from which we estimate a spin hopping localization length of 100 nm.

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