Finite Size Effects in Graphene Network

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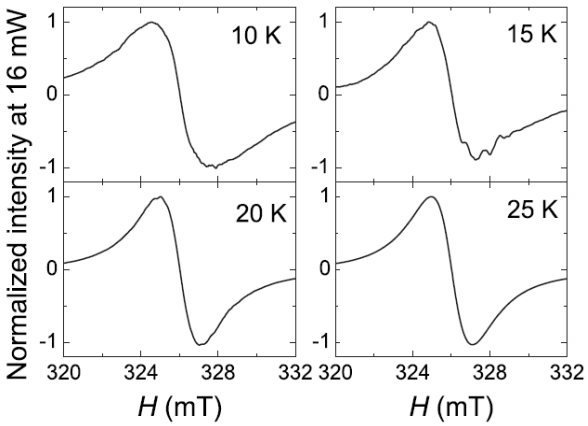
ABSTRACT

The magnetism and its dynamical behavior is investigated in relation to electron-localization effect for the edge-state spins of three-dimensional randomly networked nanographene sheets which interact weakly with each other. The electron transport is governed by Coulomb-gap variable-range hopping between nanographene sheets. At high temperatures, the electron spin resonance ESRsignal with a feature of homogeneous spin system reveals the bottleneck effect in the spin relaxation to the lattice for a strongly coupled system of edge-state spins and conduction electrons, in a given nanographene sheet. Below 20 K, a discontinuous ESR line broadening accompanied by hole-burning proves the formation of an inhomogeneous spin state, indicating a static spatial distribution of on-resonance fields. This inhomogeneity originates from a distribution of the strengths of the ferrimagnetic moments on the individual nanographene sheets, taking into account that the constituent nanographene sheets with their shapes randomly varying have different strengths of ferrimagnetic moments. Strong electron localization below 20 K in the internanographene electron hopping is responsible for the crossover from the homogeneous spin state to the inhomogeneous one, in the latter of which ferrimagnetic short-range ordering is evident in the edge-state spin system.



Keywords: magnetism, graphene, paramagnetic resonance

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