The influence of boron doping on magnetic properties of oxygen-eroded graphite

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Pristine graphite is diamagnetic. Structural disorder of graphite, topological defects or absorbed guest atoms can give rise to the change in localized electronic states which cause an increase in the density of π-states at the Fermi level and trigger anomalous behavior in magnetic field. Room-temperature magnetism has been observed in several types of carbon materials [1]. At the same time, too many defects are predicted to destroy magnetism [2].

Surface oxidation route turns bulk graphite into a foamy-like highly-defective graphitic structure, its magnetism reported in [3]. Boron is well-known as a catalyst of graphite-oxidation reaction [4]. On the other hand, it acts as a dopant for carbon system and can change the relative occupancy of π-bands.

Here we present a comparison of magnetic properties of oxygen-eroded graphite with different boron content.

The impurity analysis performed with HR-ICP-MS proved that magnetism of the samples does not correlate with content of transition metal impurities, thus confirming the results obtained in [3]. From DC magnetic measurements performed at a Quantum Design SQUID magnetometer (MPMS-XL-1) on microcrystalline powder samples we found that non-metal impurities have strong influence on sample magnetism.

It has been found that introduction of boron doping induces paramagnetic component of magnetization and, for high concentrations, significantly decreases spin concentration due to annihilation of localized states, while for smaller concentrations of boron magnetization is enhanced. The results are in line with theory predictions [5].

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