A X- and W-band EPR study of carbon related dangling bonds in SiCN and SiCN/Fe ceramics

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SiCN is a new class of materials for high-temperature electronics. Magnetic properties of SiCN materials doped with different transition metal ions can vary from paramagnetic to superparamagnetic and to ferromagnetic [1]. Superparamagnetic materials are potentially useful in developing high-temperature sensor devices [2]. Consequently, investigation of SiCN ceramics and its conductive and magnetic derivatives is currently of great interest. The SiCN ceramics consists of SiCN nanoparticles (Si_3N_4 -like structure), which are covered with graphene layers [1,2]. Further, sp^2 and sp^3-carbon related dangling bonds, which are usually formed in this graphene layers [3,4], could be investigated by EPR, a powerful technique to detect various types of paramagnetic defects. The X-band narrow EPR line near g = 2.00 is due to two carbon related dangling bonds [3]. It is structureless at X-band, but at W-band these signals become resolved. The EPR study of SiCN ceramics, annealed at 1100° C was carried out at 300 K at W-band (93.96 GHz). The two observed W-band EPR lines are due to carbon-related sp^2 and sp^3-dangling bonds. The EPR line with g = 2. 0033 is associated with sp^3-carbon related dangling bonds in amorphous carbon and the EPR line with g = 2.0011 is associated with sp^2-carbon related dangling bonds, which are located in broken aromatic rings of graphene layers, similar to that, observed in treated diamond [5]. Relative intensities of these two EPR lines depends on annealing temperature.

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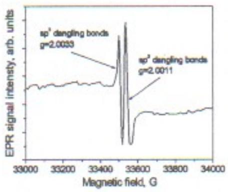

Figure 1. W-band EPR spectrum of SiCN/Fe ceramics in the range 33,000 - 34,000 G.

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