

EPR/FMR, FTIR, X-Ray and Raman investigations of Fe-Doped SiCN Ceramics

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Abstract

SiCN magnetic ceramics doped with Fe ions were synthesized at different pyrolysis temperatures in the range from 600 to 1600°C. Several phases of ceramics were detected using the techniques of electron paramagnetic resonance/ferromagnetic resonance, Raman, Fourier-transform infrared and X-ray diffractometry, listed as follows: (a) transformation to the ceramic state from the polymer state, where the Fe ions are in the paramagnetic state, as the temperature is increased from 600 to 800°C; (b) formation of two different Fe species in the range of 950-1150°C: nanocrystalline particles in the ferromagnetic state and Fe ions incorporated into the free-carbon state in the superparamagnetic state; (c) diminution of the free-carbon content above 1150°C, and, as a consequence, diminution of the intensity of the broad Fe signal related to this phase; (d) appearance of a new Fe phase at about 1200°C; (e) disappearance of the ferromagnetic phase at about 1400°C; (f) disappearance of all Fe ions above 1530°C. The samples exhibiting superparamagnetic behavior are potentially useful in developing high-temperature magnetic sensor devices. © 2010 Springer.

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