3 - 14 Magnetic Properties of SiC-Fe Composite

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SiC ceramics are promising candidate materials for future advanced nuclear energy system, due to the unique properties such as superior high temperature mechanical properties, high temperature chemical inertness and low neutron capture cross section[1,2]. Furthermore, some transition metals such as Fe, Co and Ni could be introduced into SiC so that the material obtained magnetic properties[3] and could be conveniently driven by the electromagnetic force. Compared with Co and Ni, Fe owns the lowest neutron capture cross section. In view of this consideration, the metal matrix composite SiC-Fe was designed.

The SiC-5%Fe samples were provided by the Fujian Institute of Research on the Structure of Matter. Sample 1#, 2#, 3# and 4# were from different positions of a whole sample. X-ray diffraction (XRD) patterns were obtained with a Rigaku D/Max-2400 diffractometer with a rotating anode and Cu Kα radiation (λ = 0.15418 nm). The Room temperature hysteresis loops and magnetization versus temperature curves were measured with a Lake Shore 7304 vibrating sample magnetometer.

The structure information of the samples was obtained from XRD, which indicated that the main crystal structure was 6H-SiC and magnetic phase Fe_3Si (Fig. 1). Fig. 2 shows the room temperature hysteresis loops. All the samples show ferromagnetic behavior with coercivity and magnetic remanence. The coercivity was between 24 Oe and 49 Oe, displaying obvious soft magnetic property. The maximum value of the saturation magnetization was 0.882 emμ/g. Fig. 3 shows magnetization versus temperature curves, the monotonically decreasing curves reflected the expected thermally induced decay of magnetization. The Curie temperature of the samples could be detected from the magnetization versus temperature curves. The Curie temperature of the samples was between 436 and 539 °C, which decided the working temperature of the material.

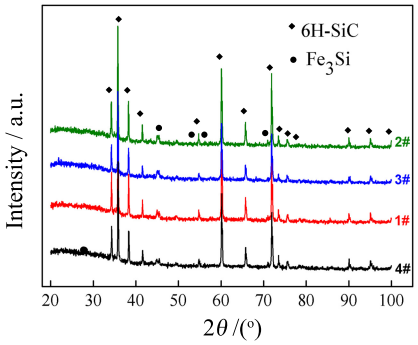

Fig. 1 (color online) The XRD of SiC-5%Fe.

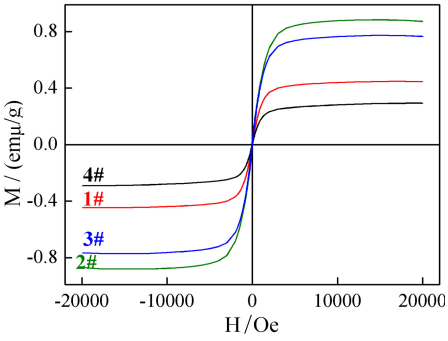

Fig. 2 (color online) The room temperature hysteresis loops of SiC-5%Fe.

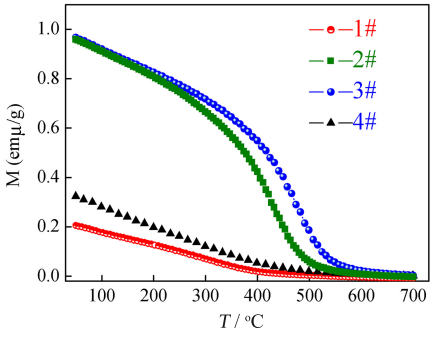

Fig. 3 (color online) Magnetization versus temperature curves of SiC-5%Fe.

In summary the crystal structure and magnetic properties were investigated. The samples show ferromagnetic behavior with a relatively high Curie temperature. However samples' magnetization was too low. In order to improve the properties of this material, more work would be carried out.

Table 1 Saturation magnetization (M_s), remanence (M_r), coercivity (H_C) and Curie temperature (T_C) of the samples.

Sample	M_s / (emμ/g)	M_r / (emμ/g)	H_C / Oe	T_C/°C
1#	0.447	0.013	33	436
2#	0.882	0.031	49	495
3#	0.771	0.026	41	539
4#	0.292	0.007	24	467

References

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