

Rapid carbothermal synthesis of nanostructured silicon carbide particles and whiskers from rice husk by microwave heating method

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【Introduction】 Recently, the microwave heating method has been developed to synthesize SiC. In microwave heating, energy is delivered to the materials via molecular-level interactions with the electromagnetic field. Compared with conventional heating methods, microwave heating offers many advantages such as rapid, selective and volumetric heating, high reaction rates and dramatically reduced reaction times. In this paper, we report a simple and rapid way to fabricate nanostructured SiC from RH by a microwave heating method.

【Experimental】 As shown in Fig. 1, the CRH powder was placed in an alumina crucible that was fixed in the insulator. The temperature of the samples was measured by an infrared pyrometer. Prior to starting the microwave furnace, high purity argon (>99.999%) gas was flowed into the alumina crucible at a constant flow rate of 2L/min. The heating-up time was fixed and the samples were heated to the setting temperatures in only 25min of microwave exposure. Different synthesis experiments were carried out in the temperature range of 1100–1500°C for 60min and at 1500°C for 5, 15, and 30min.

【Results】 Fig. 2 shows the XRD patterns of the products synthesized by microwave heating method with the excess carbon being removed by calcination. The typical peaks at $2\theta=35.6^\circ$, 41.4° , 60.0° , 71.8° and 75.5° can be indexed as (111), (200), (220), (311) and (222) reflections of β -SiC structure (JCPDS Card No. 29-1129). The peak at 33.6° marked with SF corresponds to the stacking faults of β -SiC. A halo between 15° and 30° can be observed on the XRD patterns of the products synthesized at 1100–1200°C for 60min and at 1500°C for 5min, indicating that the carbothermal reduction of SiO_2 is not complete and the unreacted SiO_2 is still amorphous. As to the products obtained at 1300–1500°C for 60min and at 1500°C for more than 15min, no typical peak of SiO_2 can be detected, revealing that a complete carbothermal reduction reaction is achieved.

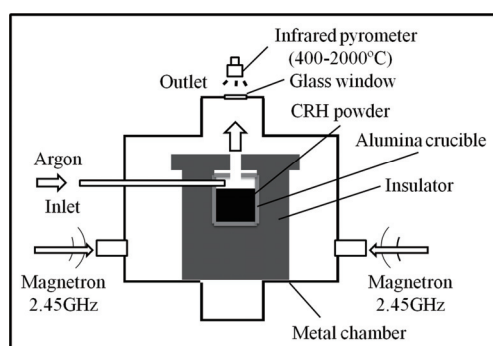


Fig. 1. Schematic diagram of the microwave heating apparatus.

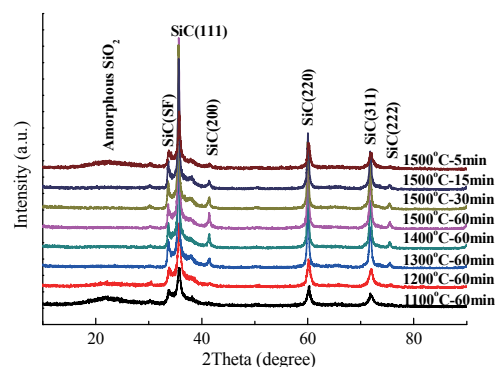


Fig. 2 XRD patterns of the products synthesized by microwave heating (after calcination).