

Pulsed discharging of compacted B powder for ZrB_2 nanoparticle preparation

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Pulsed wire discharge (PWD) is a physical vapor method for preparing nanoparticles. In this method, a thin metallic wire is vaporized by a large pulsed current and rapidly quenched in ambient gas/liquid to form nanoparticles. Basing on PWD, pulsed discharge of powder was proposed to prepare nanoparticles of boron which is difficult to draw wire[1]. In this research, pulsed discharge of powder was utilized to prepare nanoparticles of zirconium boride (ZrB_2). ZrB_2 is a refractory ceramic material. It has relatively low density, good high temperature strength, high hardness and high electrical conductivity so it is promised to be applied in high temperature applications as well as aerospace industry. Nanosized ZrB_2 is expected to improve the strength of material by Hall-Petch strengthening. In this experiment, micro-sized crystalline B powder was compressed in a heat-shrinkable tube with a pair of Zr rods and discharged by a large pulsed current. To discharge, three banks of capacitors (each 10 μF) were charged to 6.2 kV and the discharging were done inside a chamber filled with Ar gas at 100 kPa. Experimental apparatus is shown in Fig. 1. From XRD pattern in Fig. 2, beside minor phases of oxide of Zr and compounds of Zr and B were be formed, ZrB_2 is considered to be successfully prepared.

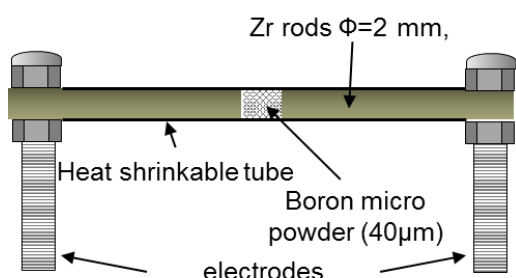


Fig. 1. Experimental setup for ZrB_2 nanoparticles preparation by discharge compacted powder.

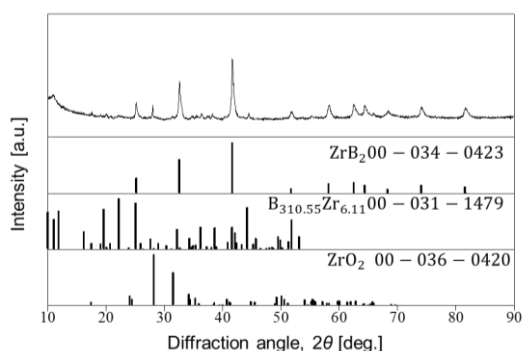


Fig. 2. XRD pattern of ZrB_2 nanoparticles using Zr rods.

References:

- [1] D.H. Nguyen et al., Japanese Journal of Applied Physics, 2019 (in press)