Growth of Superconducting MgB_2 Fibers by a Diffusion Method

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Superconducting MgB_2 fibers are grown by a diffusion method. The fibers are prepared by exposing B filaments to Mg vapor inside folded Ta foil over a wide range of temperature and growth time. The materials are sealed inside a quartz tube by gas welding. The as-grown wires are characterized by scanning electron microscopy and energy dispersive x-ray analysis. The resulting wires have a diameter of about 100 μm. Surface morphology of the fibers turns out to be strongly dependent on growth temperature and mixing ratio of Mg and B. Radial distribution of Mg ions into B is observed over the cross-sectional area. Optimal conditions of uniform diffusion of Mg have been explored. Transport properties of the MgB_2 fibers are examined by a physical property measurement system. MgB_2 fibers grown at 900 °C for 2 hours show a superconducting transition at 39.8K with $\Delta T_c < 1.5$. Resistivity vs. temperature curves indicate that MgB_2 has ρ(40K)=2.04 $\mu\Omega$ cm and ρ(300K)= 29.50 $\mu\Omega$ cm. The electrical resistivity of the wires was measured in magnet field from 0T to 8T. From this measurement, it is estimated that the upper critical field H_{C2} at 4K is more than 9T. In addition, a small amount of magneto-resistance was detected at high magnetic fields. We will discuss potential applications of MgB_2 fibers for long-length superconducting wires

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