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M3Or3B-02: Effect of swaging on the microstructure and critical currents of single- and 7-filament powder-in-tube MgB₂ wires

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Critical current density (J_c) of in-situ powder-in-tube(PIT) processed MgB₂ has still to be improved for practical applications. One of the problems of in-situ PIT MgB₂ wires is the low mass density of MgB₂ core. The density of MgB₂ core of in-situ PIT wire fabricated by the conventional technique is as low as ~50%. It is considered that the microstructure of Mg/B powder cores including the density before a heat treatment in situ PIT processed wires depends on the mechanical deformation process. We found that a wire fabrication by applying a swaging machine is much effective in increasing the density of Mg/B mixed powders and hence the density of MgB₂ core. Vickers hardness of MgB₂ core after the heat treatment increased from ~120 for groove rolled and drawn wire to ~250 for swaged wire. MgB₂ wire fabrication by swaging machine is also effective in obtaining well developed fiber structure of Mg particle. This leads to the fiber structure of MgB₂ in the wire. Furthermore, improved uniformity of MgB₂ core along the longitudinal direction is obtained by swaging. These three factors much contribute to the increase of J_c values of in situ PIT MgB₂ wires. Highest J_c values of 7-filamentary wires fabricated with 4.5%C-coated B powder and by applying only swaging are ~32,000A/cm² at 4.2K and 10T. These J_c values are about twice as high as those of the wires fabricated with the combination of groove rolling and drawing.

Primary author: Dr KUMAKURA, Hiroaki (National Institute for Materials Science)

Co-authors: Mr TAKIGAWA, Hiroyuki (National Institute for Materials Science); MATSUMOTO, Akiyoshi (NIMS)

Presenter: Dr KUMAKURA, Hiroaki (National Institute for Materials Science)

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