Abstract

The new MgB2 superconductors: present status and future perspectives

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Ten years have already passed since the striking discovery of superconductivity in MgB2 was announced by Prof. Akimitsu et al and published in Nature. While this appreciable amount of time has elapsed, many unusual features distinctive of this compound have been observed and mostly understood, and its potential for becoming a useful superconductor for practical applications on a short-term basis has constantly increased.

So far MgB2 is the known binary compound with the highest critical temperature, and thanks to its large coherence length, and limited anisotropy, it can be manufactured in long conductors by means of the Powder-In-Tube method, without having the necessity to texture the material, or to take special care of the grain boundaries, the real limiting factor for the performance of HTS materials in wire form.

The low cost of the precursors, i.e. Magnesium and Boron powders, and their acceptable chemical compatibility with most of the workable metals and alloys that can constitute the sheath of Powder-In-Tube composite wires, as Nickel, Iron, Titanium and Chromium, to name a few, make the overall materials cost estimation for MgB2 wires absolutely competitive with existing technologies.

A significant effort is currently underway to develop and produce long MgB2 wires and strands useful for assembling large current MgB2 power cables for a number of applications. While the cooling penalty of operating MgB2 cables at temperatures in the range between 15 and 30 K is larger than for HTS, the superior cost/performance ratio of MgB2 conductors, particularly when the capability to employ round wires is also taken into consideration, contributes to achieve an attractive overall cable cost.

The manufacturing process of MgB2 wires will be reviewed as it is today, and the efficacy of it will be demonstrated by mentioning some of the products as well as prototypes which are currently under fabrication through it, as medical devices (MRI), smart grid related components (SFCL), industrial processes (NMR, induction heating).

While the performance achieved today on multi-Km long wires is already sufficient to motivate industrial MgB2 wire production, it is also very well known that the potential of this compound is still from being fully reached, as lab-scale materials produced in thin and thick film-like shape show critical current densities larger by almost two orders of magnitude than that of round wires, and upper critical fields above 60 Tesla. Therefore the potential for future improvements of MgB2 wires by means of cost-effective methods will be finally discussed.