A New Generation of *in situ* MgB_2 Wires with Improved J_c and B_{irr} Values Obtained by Cold Densification (CHPD)

René Flükiger, Md. Shahriar Al Hossain, Carmine Senatore,
Florin Buta and Matt Rindfleisch

Abstract - By means of Cold High Pressure Densification (CHPD), the critical current density, J_c, of binary and alloyed MgB_2 wires has been enhanced by more than a factor 2 at 4.2K and at fields up to 19 T. The relative MgB_2 mass density of binary MgB_2 wires was enhanced to ~ 54 % after applying 2.5 GPa at 300 K before reaction. In $C_4H_6O_5$ (malic acid) alloyed wires, densification also caused the enhancement of B_{irr}, as a consequence of a slightly enhanced C content, determined by X ray diffraction. Almost isotropic J_c values were obtained for $C_4H_6O_5$ added wires of 1 x 0.6 mm^2 cross section, the values of $J_c(4.2K)=1x10^4$ A/cm^2 for parallel and perpendicular fields being obtained at 13.8 and 13.4 T, respectively (1 μV/cm criterion). The corresponding values for 20K were both close to 6.2 T. The value of $Birr^{//}$ at 20K was 11 T. The positive effects of cold densification on J_c and B_{irr} on MgB_2 was also observed on 150 mm long wires alloyed with $C_4H_6O_5$ or with SiC, by the succession of 6 overlapping pressure steps. This process can be extended to long wire lengths: by means of a newly developed prototype machine with an automatic press/release/advance sequence, a first wire length of 1 m was densified at 1.5 GPa, yielding $J_c(4.2K) = 1x10^4$ A/cm^2 at 13.1 T. Further improvements are expected after optimization.

Index Terms - MgB_2, cold densification, critical current density, upper critical field, electrical resistivity.

IEEE/CSC & ESAS European Superconductivity News Forum (ESNF), No. 14, October 2010
The published version of this manuscript appeared in *IEEE Transactions on Applied Superconductivity* 21, Issue 3, 2649 - 2654 (2011)