High Energy Ball-Milling and Synthesis Temperature Study
to Improve Superconducting Properties of MgB$_2$ ex-situ Tapes and Wires

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Abstract—MgB$_2$ monofilamentary nickel-sheated tapes and wires were fabricated by means of
the ex-situ powder-in-tube method using either high-energy ball milled and low temperature
synthesized powders. All samples were sintered at 920°C in Ar flow. The milling time and the
revolution speed were tuned in order to maximize the critical current density ($J_c$) in field: the
maximum $J_c$ value of 6 x 104 A/cm$^2$ at 5K and 4T was obtained corresponding to the tape
prepared with powders milled for 144h at 180rpm. Various synthesis temperature were also
investigated (730-900°C) finding a best $J_c$ value for the wire prepared with powders synthesized
at 745°C. We speculate that this optimal temperature is due to the fluidifying effect of unreacted
magnesium content before the sintering process which could better connect the grains.

Index Terms — critical current, magnesium diboride, ex-situ, high energy ball-milling, synthesis
temperature

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