MgB_2 superconducting wires with an *ex situ* MgB_2 barrier: fabrication optimization for large-scale production

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This work builds on the concept of using an *ex situ* MgB_2 barrier in superconducting wires to eliminate the need for costly niobium shields [1]. Previous studies demonstrated that the MgB_2 barrier effectively prevents interactions between the superconducting core and the surrounding sheath while enabling the use of more economical materials [2], [3].

Further research established the feasibility of producing long-length superconducting wires with an *in situ* MgB_2 core, an *ex situ* MgB_2 barrier, and a copper sheath [4]. The Prosuprex project (2019–2023) developed a production process for large PIT billets (Ø70 mm) suitable for drawing continuous wires up to 3 km long with a diameter of Ø0.8 mm. The first multi-core *in situ*/*ex situ* wires fabricated from the resulting monofilament wires achieved a critical current density (J_c) of approximately 250 A/mm^2 at 20 K in self-field.

The present study focuses on optimizing the fabrication process of these wires to enable reliable and cost-effective large-scale production. Particular attention is paid to processing parameters affecting barrier integrity, core and barrier densification, and the mechanical performance of the composite wire. The powder density in the green billet (before mechanical deformation) was increased from ca. 30% to over 50%. The influence of the optimized fabrication route on the superconducting properties and overall structural quality of the wire was also evaluated, resulting in a critical current density (Jc) of approximately 600 A/mm^2 at 20 K in self-field.

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References

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