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Towards an affordable FCC: TMC superconducting wires as alternative?

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Ternary Molybdenum Chalcogenide (TMC) superconductors were intensely studied until the mid 1990s. Although TMC's are low temperature superconductors (Tc ≤ 15 K), they show upper critical fields up to 60 T. R&D for TMC superconducting wires were carried out by academia and industry, e.g. Alstom (F), Mitsubishi (J) and Plansee (A). Recently it was found that the $/kgpriceandthe/$kAm performance index of TMC superconducting wires are almost one order of magnitude less than HTS tapes/wires. TMC may even be competitive in the field range above 15 T. Other advantages with respect to HTS are: isotropic physical properties, round or rectangular cross sections of wires, no reaction heat treatment, cabling like common stainless steel cables, yield strength above 800 MPa, no limitation of filament size, etc.
The most promising process for TMC superconducting wires was developed by Plansee over about 15 years. The matrix of such a wire is stainless steel with TMC filaments protected by a molybdenum diffusion barrier acting also as a stabilizer (instead of copper). Wire drawing was carried out on a production line for molybdenum wires and unit lengths up to 1 km were achieved. Today, further industrial development of these wires seems to be worth and would be beneficial for FCC and industry.
In this contribution, the status of TMC superconducting wires is reviewed. Experimental evidence is given how the critical current density, not yet optimized, can be improved substantially by replacing the usual Powder In Tube (PIT) process. The new process, documented in a PCT patent application (pending), deals with the extrusion and wire drawing of TMC bulk material (instead of powder) allowing critical current densities well in the scope of FCC.

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