Iron Based Superconductors: Development of Conductors for High Field Generation based on Fe(Se,Te)

V. Braccini[1], M. Iebole[1], N. Manca[1], A. Malagoli[1], A. Martinelli[1], E. Bellingeri[1], G. Grimaldi[2], A. Leo[2], M. Scuderi[3], M. Cialone[4], M. Putti[4], M. Fracasso[5], R. Gerbaldo[5], G. Ghigo[5], L. Gozzelino[5], F. Laviano[5], D. Torsello[5], G. Celentano[6], L. Piperno[6], F. Rizzo[6], A. Vannozzi[6]

[1] *CNR – SPIN Genova, Corso Perrone 24, 16152 Genova, Italy*
[2] *CNR – SPIN Salerno, Via Giovanni Paolo II 132, 84084 Fisciano, Salerno, Italy*
[3] *CNR – IMM Catania Headquarter, Strada VIII 5 Zona Industriale, 95121 Catania, Italy*
[4] *Physics Department, University of Genova, Via Dodecaneso 33, 16146 Genova, Italy*
[5] *Politecnico di Torino, Corso Duca degli Abruzzi, 24 - 10129 Torino, Italy*
[6] *ENEA, Frascati Research Centre, Via E. Fermi, 45 – 00044 Frascati, Italy*

Iron-based superconductors (IBS) are promising candidates for the production of high-field superconducting magnets, such as for the magnetic confinement of plasma in nuclear fusion power plants or for accelerator magnets in high-energy physics. Specifically, the Fe(Se,Te) family offers advantages over ReBCO in terms of simplicity of Coated Conductor architecture and robustness towards irradiation. We studied and optimized the deposition of Fe(Se,Te) thin films on CaF_2 and YSZ single crystal substrates, as well as on biaxially textured NiW tapes with a Zr-doped CeO_2 buffer layer, resulting in the first fully home-made Fe(Se,Te) Coated Conductors with a simplified architecture [1, 2, 3].

We focused on the effects of particle irradiation either to create controlled distributions of defects, tuning the pinning mechanisms and improving parameters useful for applications such as critical current and irreversibility field, and at the same time to be able to define damage thresholds above which degradation of the superconducting properties might occur. This aspect is crucial for applications where high radiation levels are expected (e.g. fusion).

We performed several experiments with various particles and fluences, which determine different defect types. We found out that Fe(Se,Te) is highly resistant to high-energy proton-induced damage [4]. Irradiations with heavy ions like Au and Pb provided an increase of the critical current density and irreversibility field at specific matching fields. In both the cases, the irradiation effects also depend on the substrate.

In this talk I will review the steps towards a Fe(Se,Te) based Coated Conductor, focusing in particular on the effects of irradiation on structural and transport properties of this phase.

References

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