Development of Fe(Se,Te) coated conductors with a conductive TiN buffer layer

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The feasibility of tapes based on Iron-Based Superconductors (IBS) has garnered significant interest for their potential in low-temperature and high-field applications. Among them, Fe(Se,Te) coated conductors can compete with much mature technology if simpler and cheaper architecture can be developed.

We propose a simplified coated conductor architecture on biaxially textured substrates (RABiTS) with a single conductive buffer layer. In this design, the thermal and electrical stabilization of the tape can be achieved through the metallic substrate. The architecture is based on an epitaxial thin TiN buffer layer on Ni-W substrates [1].

Using TiN as buffer layer introduces the challenge of a large lattice mismatch between Fe(Se,Te) and TiN. We adopt a seed layer strategy which has proven effective in addressing significant mismatch issues, as well as reproducibility of superconducting properties [2, 3]. Superconductive Fe(Se,Te) film is deposited via a two-step approach. First, Fe(Se,Te) seed layer showing a sharp biaxial texture, is grown on TiN buffer layer at a relatively high deposition temperature, about 400 °C. Then, the deposition at low temperature, 200-250 °C, of a Fe(Se,Te) top layer assures the tape superconductive performance by favoring the incorporation of volatile element [4].

The correlation between the Fe(Se,Te) bilayer (top + seed) microstructure and superconductive properties have been studied. High critical current density value, with J_C above 0.1 MA/cm^2 at 4.2 K up to 17 T, and a J_C value of about 2 MA/cm^2 at 4.2 K and self-field, have been observed as result of an extremely effective pinning landscape induced by the presence of nanostructured superconducting grains with a high density of low angle grains boundaries.

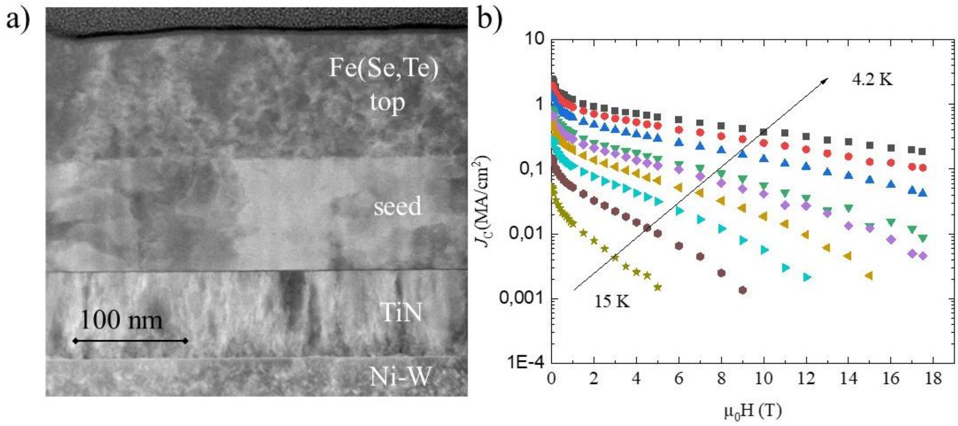

Figure 1: Fe(Se,Te)(top+seed)/TiN/Ni-W architecture a) FIB/SEM cross section image b) magnetic in-field dependence of the critical current density.

References

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