Highlights

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The role of texturing and thickness of oxide buffer layers in the superconducting properties of Fe(Se,Te) Coated Conductors

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Fe(Se,Te) CC were realized with new templates developed to be simple, scalable, cost effective and to have a good chemical barrier against Ni diffusion and a suitable texturing. The goal of the work was gaining information on the roles of thickness and texturing of the oxide buffer layer. The results obtained employing a well textured NiW5% substrate with CeO_2 buffer layer of different thickness - 150 or 350nm - were compared to the results obtained using a randomly oriented Hastelloy substrate with native oxide of different thickness – i.e. 10, 130 or 400nm. Both kinds of substrates employ only one oxide buffer layer, significantly simplifying the realization of the CC, and the Hastelloy substrate would even employ a native oxide layer, which allows skipping the complex deposition of the oxide buffer. Regardless texturing, as long as the buffer layers are too thin they are not efficient in blocking the Ni diffusion from the substrate, causing the poisoning of the Fe(Se,Te) phase. Accordingly, bulk superconductivity with $T_{c,0}$ of 11.1K and 16.5K were observed respectively for films deposited on randomly oriented Hastelloy substrate covered with a 400nm native (not oriented) oxide and on 350nm thick very well textured CeO_2 buffer layer grown on biaxially textured NiW5% alloy. In Fig. 1 we report the H-T diagrams of the films on the two different systems, while in Fig. 2 the J_c behaviour in field which outlines how the J_c magnitude is strongly dependent on the texturing. Fe(Se,Te) thin film deposited on the untextured native oxide grown on Hastelloy are partially orientated along the c-axis, with both in plane and out of plane misalignment and they exhibited self-field J_c much lower than those obtained in epitaxial thin films, but still significant and the same as the one measured on thin films grown on bi-crystals with misalignment angles larger than 24°, suggesting that J_c in this film, is ultimately limited by high misalignment between grains, responsible for a weak link dominated scenario. From this study we concluded that the properties of Fe(Se,Te) CC are strongly related to the texturing and thickness of the buffer layers, which both contribute to the final superconducting properties of the phase. In particular, it has been shown that it is possible to fabricate superconducting CCs on templates consisting of randomly oriented substrates covered with native oxides.

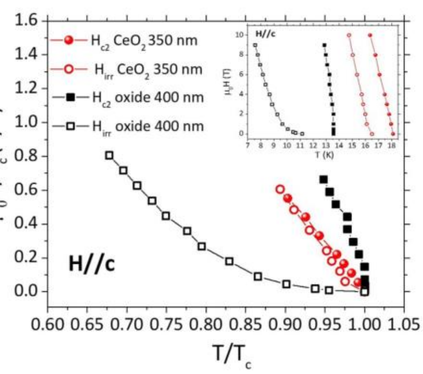

Fig. 1: H-T diagrams of the 11 thin films deposited on the Hastelloy and on the RABiTS substrates with 350 nm of CeO_2 oxide (red). H_{c2} and H_{irr} were obtained using the criteria of 10% and the 90% of the normal state resistivity.

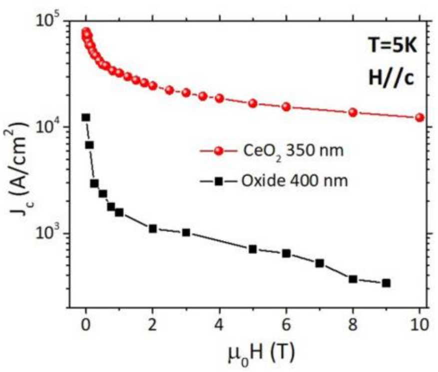

Fig. 2: J_c at 5 K vs applied magnetic field of the 11 thin films deposited on Hastelloy substrate with 400 nm of oxide (black) and on the RABiT substrate with a 350 nm thick CeO_2 buffer layer (red).