Superconducting properties of Co-doped Ba122 grown on NiW RABiTS tapes

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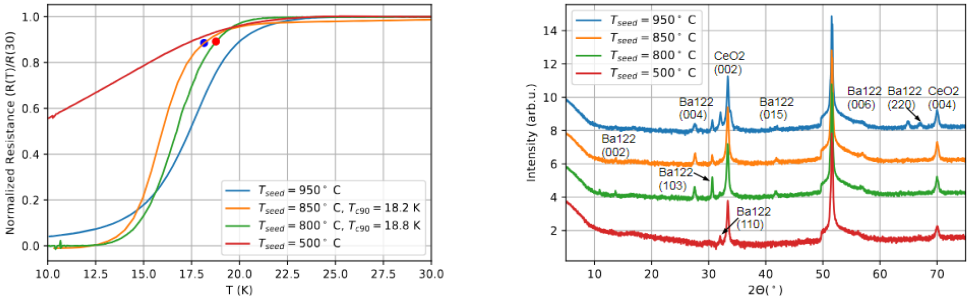
Recently it was shown that Fe(Se,Te) may be suited as a superconducting material for coated conductors. Piperno et al. showed its growth on low-cost buffer layers [1], and Liu et al. demonstrated 1 m of Fe(Se,Te) coated conductor deposited in a reel-to-reel multi-turn system [2]. The aim of this work is to investigate whether $Ba(Fe,Co)_2As_2$ (Ba122) is equally suitable for Fe-based superconducting coated conductors. For this purpose, we deposited $Ba(Fe,Co)_2As_2$ with pulsed laser deposition onto CeO_2-buffered NiW RABiTS tapes. Depositions of $Ba(Fe,Co)_2As_2$ on IBAD MgO coated conductor templates have been realized using an iron buffer layer architecture [3]. However, the deposition of $Ba(Fe,Co)_2As_2$ on CeO_2 have not yet been carried out. The structural quality and superconducting properties of the films are determined with X-ray diffraction, as well as resistive and inductive T_c measurements. Initial films showed mis-oriented growth and only partial superconductivity. In order to improve the film quality, seed layers of differently doped Ba122 are introduced, as utilized for Fe(Se,Te) already [1], which should create good growth conditions and prevent oxygen diffusion of CeO_2. Films with 8 % doped seed layer show the best results regarding the width of the superconducting transition, film quality and T_c (18.8 K), see Figure. Depositions on both parent and 3 % doped Ba122 seed layers reveal a thickness dependence of the superconducting layer. This observation suggests Co-diffusion from the main superconducting layer into the seed layer. Variations in laser repetition rate during deposition of 3 % doped seed layers to reduce effects of Co diffusion lead to an improved film texture but also to an increased formation of mis-orientations. A comparison of the atomic distances within Ba122 and CeO_2 shows that the growth modes, especially of (103) and (110) misorientations compete with the (00*l*) oriented growth. Furthermore, annealing experiments were performed to improve the structural quality of the films.



Left: Temperature dependence of the normalized resistance of $Ba(Fe,Co)_2As_2$ samples on metal tapes with varying seed layer deposition temperatures. **Right**: $\Theta - 2\Theta$ scans of $Ba(Fe,Co)_2As_2$ films deposited on 8 % Co-doped seed layer in dependence of seed layer deposition temperature.

References

[1] Laura Piperno, Angelo Vannozzi, Andrea Augieri, et al. High-performance Fe(Se,Te) films on chemical CeO_2-based-buffer layers. Scientific Reports 13, 569 (2023)

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[3] Kazumasa Iida, Jens Hänisch, Sascha Trommler, et al. Epitaxial Growth of Superconducting Ba(Fe1-xCox)2As2Thin Films on Technical Ion Beam Assisted Deposition MgO Substrates. Applied Physics Express 4, 013103 (2010)