Grain boundaries in Fe(Se,Te) thin films

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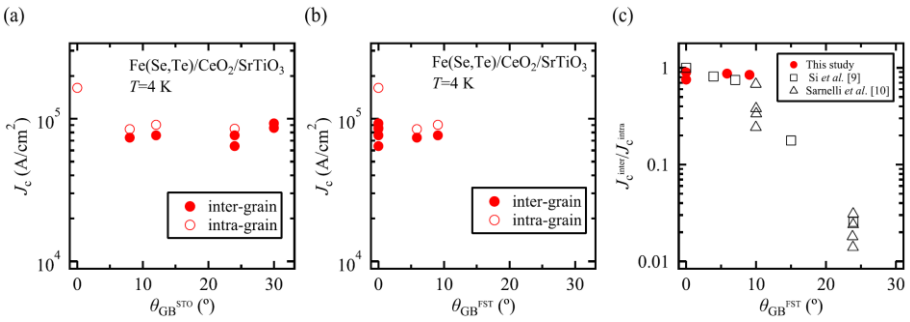
Due to the short coherence length in Fe-based superconductors (FBS), grain boundaries (GBs) with sufficiently large angles and hence interface widths are capable of limiting the supercurrent flow. They form weak links. This is very similar to the cuprate high-temperature superconductors (HTS) [1], yet with somewhat larger critical angle and less severe reduction in critical current density J_c at large angles [2]. This has been evaluated for several classes of FBS, namely Co- or P-doped $BaFe_2As_2$ [3], Fe(Se,Te) [4], and NdFeAs(O,F) [5] on [001]-tilt GBs only.

For the cuprates, other types of GBs have been investigated as well, and it turned out that the J_c reduction seems to depend to some extend on the type of GB [6]. Whereas J_c across [100]-twist type GBs reduced significantly in $YBa_2Cu_3O_7$ (similar to [001] tilt), it was unaltered for [001]-twist GBs in $Bi_2Sr_2CaCu_2O_{8-\delta}$ [7]. [010]-tilt GBs showed a slightly larger critical angle and J_c values. This indicates that both θ_c and J_c may depend on the type of GB.

Here, we show structural and transport properties of Fe(Se,Te) films on CeO_2-buffered $SrTiO_3$ bicrystal substrates with [010]-tilt (roof-top) and [100]-twist GBs. Interestingly, both the superconducting film and the buffer layer show different GB angle offsets to the substrate. This is explained by phase matching epitaxy, and the transport is evaluated according to the real GB angle in Fe(Se,Te) [8], see figure.



J_c of the inter- and intra-grain bridges in Fe(Se,Te) films on STO bicrystal substrates as a function of grain boundary angle inSTO θ^{STO} (a) and in Fe(Se,Te) θ^{FST} (b)at 4 K. J_c is nearly constant at ~80 kA/cm^2 except for the film grown on the ordinary $SrTiO_3$ (θ_{STO}=0). (c) Normalized J_c vs. θ^{FST} in comparison to data of [001]-tilt GBs (open symbols). [8]

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