Transport Properties of the Stainless Steel/Ag-sheathed $Ba_{1-x}K_xFe_2As_2$ Tapes with Large Critical Current Density

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After achieving the practical level of 10^5 A/cm^2 at 4.2 K and 10 T by the iron-based superconductors (IBSs) Ag-sheathed $Ba_{1-x}K_xFe_2As_2$ (Ba122) tapes [1], the improved stainless steel (SS)/Ag-sheathed Ba122 tapes have made a brand-new record which leapt over 2×10^5 A/cm^2 at 4.2 K and 10 T [2]. This achievement suggests that it is possible for the J_c of the IBSs to get higher. To find out what is working on increasing the J_c and how it influences the transport properties, we studied magnetic field and angular dependences of J_c of the high-performance SS/Ag-Ba122 tapes and compared them to the Ba122 tapes with other sheathes.

The magnetic field dependence of J_c, J_c-B, was measured under both increasing and decreasing B at different magnetic field angles, in order to evaluate the anisotropic hysteresis behaviors. Obviously, the SS/Ag-Ba122 has smaller hysteresis in J_c in relatively low field region below 2~3 T than about 8~10 T of the Ag- and Cu/Ag-sheathed Ba122 tapes. It suggests the improved grain connection and texture. While the J_c-B curves with decreasing B at different angles are all monotonic before a drop when $B \approx 0$ T, the J_c-B curves with increasing B show different behaviors depending on the angles. For example, J_c increases by applying the magnetic field from 0 T to 0.2 T, then turns to reduce until 18 T at $\theta = 0°$ while for $\theta = 90°$, J_c reversely reduces from 0 T to 0.2 T, then turns to increase to reach a peak at 2 T (B_{peak}) and finally back to reduce until 18 T. The behavior leading to the B_{peak} has been observed in our study of the Cu/Ag-Ba122 tapes, and the B_{peak} value at 90° in this study is also lower than that of the Cu/Ag-Ba122 tapes, which is about 6.5 T.

The angular dependence of J_c, J_c-θ, was measured at different magnetic fields. The J_c-θ curves are anomalous, and the J_c anisotropy is opposite to the effective-mass anisotropy. Similar to the other Ba122 tapes with good transport performance, the SS/Ag-Ba122 has the J_c anisotropy that $J_c(90°)/J_c(0°) < 1$ until 18 T. The dip of the J_c-θ around $\theta = 90^\circ$ (B //tape) appears under the whole measured magnetic field and shows slightly complicated magnetic field dependence. It is much different than those of the other Ba122 tapes such the Cu/Ag-Ba122 in the previous study, i.e, the J_c peak around $\theta = 45°$ gradually grows over 15 T [3]. As the J_c anisotropy is related to the pinning mechanism, the specific J_c-θ of the SS/Ag-Ba122 is one of the keys to reveal the way of their J_c improvement.

The experimental details and more analyses will be discussed in the presentation.

References

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