Transport properties and flux pinning analysis of high-performance $Ba_{0.6}K_{0.4}Fe_2As_2$ superconducting tapes

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Iron-based superconductors (IBS), especially 122 type, are very promising candidates for high-field applications because of its ultrahigh H_{c2} > 70 T at 20 K, low anisotropy (γ < 2 for 122) , and ease of fabrication. Recently, significant progresses on the IBS wires have been made in terms of Jc enhancement, e.g., the highest transport J_c values have achieved 0.15 MA/cm^2 (I_c = 437 A) at 4.2 K and 10 T in densified and textured 122 tapes. The transport J_c measured at 4.2 K under high magnetic fields of 27 T is still on the level of 55 kA/cm^2. Herein we compared the T_c and J_c distributions of K-doped FeAs122 tapes by a calorimetric method. We found that hot-pressing provides a better environment for a complete chemical reaction and a more homogenous dopant distribution, which are beneficial to the global current of a superconductor. We further study the vortex dynamics of the hot-pressed high-Jc tapes. We found that magnetization relaxation rate below 10 K shows a temperature insensitive plateau with a value comparable to that of low temperature superconductors. Moreover, the relaxation rate below 20 K tends to saturate with the increasing field which is beneficial for high field application. Our results indicate that the high-performance K-doped FeAs122 tapes have promising potential to be applied not only in liquid helium, but also in liquid hydrogen or at the temperature accessible with cryocoolers.

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