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Recent microstructural understanding to lead further J_c optimization of Bi-2223 tapes

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The Bi-2223 superconducting tape is the 1st generation high temperature superconductor (HTS). Due to its high T_c ~110 K, the devices made of Bi-2223 can be operated at the liquid nitrogen temperature 77 K. Especially the application of power electric utilities such as long distance power transmission cables have been investigated. Also this material is very attractive for high field magnets, since the irreversibility field (H_{irr}) becomes more than 20-30 T below 15-20 K. It has been more than a decade since Bi-2223 wires were industrialized. However, few times increase of the critical current density J_c is required in order to expand its practical applications and to make a substantial cost reduction of Bi-2223 wires. As a conductor, Bi-2223 is the most mature HTS, but in reality, there are so many unknown parameters in the manufacturing process because of the fact that Bi-2223 consists of 6 elements. In particular, the detailed structure of grains and grain boundaries and their correlations to J_c are still elusive. In recent years, we utilized high resolution Electron Backscatter Diffraction Orientation Imaging Microscope (EBSD-OIM) to visualize the grain structure in the industrial grade and proto type of Bi-2223 superconducting tapes. We found that the Bi-2223 grains are not stacked as the perfect brick wall model, but rather in the way that the c-axes are slightly tilted with a slight out-of-plane misorientation. The better out-of-plane grain alignment resulted in 24 % J_c increment. The in-plane grain orientations appear macroscopically random, but some of grains tend to form the domain structure in which the grain boundaries appear far less detrimental for J_c than previously thought. In this presentation, we will compare such microstructural features of Bi-2223 tapes and its sibling Bi-2212 round wires, and discuss the next challenge to further improve the J_c of Bi-2223 tapes.