Superconductors in High Magnetic Fields – Now and the Future

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Abstract – A development of high field superconducting magnet requires both a high in-field critical current density $J_c$ and a high mechanical strength. Most practical superconducting materials like Nb$_3$Sn, Bi$_2$Sr$_2$Ca$_x$Cu$_2$O$_y$ (Bi2212), Bi$_2$Sr$_2$Ca$_2$Cu$_3$O$_y$ (Bi2223) and REBa$_2$Cu$_3$O$_y$ (RE123, RE: rare earth and yttrium), except NbTi, are brittle and hence are weak against mechanical stress. Therefore, the reinforcement as well as the improvement of the in-field $J_c$ are necessary for high field magnet applications. The in-field $J_c$ can be improved by the introduction of strong flux pinning centers. The high strength superconducting wires and tapes have been developed by the reinforcement with a high strength material. Those novel approaches are used successfully for some practical superconducting wires. In the presentation, the flux pinning and the mechanical stress/strain properties on the advanced practical superconducting materials will be introduced and discussed for high magnetic field applications.

Keywords (Index Terms) – Practical superconductors, high magnetic fields, critical current density, mechanical properties.

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