CUPRATE SUPERCONDUCTORS FOR HIGH FIELD MAGNET USE- AN UPDATE ON THE NHMFL PROGRAM

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The era in which high field magnets could only be made from Nb-Ti or Nb_3Sn is about to come to an end now that long lengths of round wire (RW) Bi-2212 and YBCO coated conductor are becoming available. At the NHMFL we have a program to apply both these conductor materials to the construction of high field solenoids with fields of 30 T or more. RW Bi-2212 and YBCO CC are to some extent now in competition because although RW Bi-2212 has high current density well beyond 30T, the current density of YBCO CC is even higher (J_E 2212 and YBCO (H perpendicular to the tape plane ~ 500 A/mm^2 at 20T versus ~3000 A/mm^2 at 20T with H parallel to the tape plane). Recent investigations at the NHMFL have addressed the role of connectivity in determining J_c in round-wire (RW) Bi-2212, as well as the reactivity of Bi-2212 with insulations, and the way that these interact with each other in winding coils of Bi-2212. BSCCO leakage and variable connectivity are as yet unresolved issues with Bi-2212 and both produce a depressive effect on J_c. However, new processing scenarios that split the melting and 2212 growth stages offer unexpected improvements to J_c and the development of a broader HEP interest in RW conductors may soon resolve many of these issues. By contrast, YBCO coated conductors are fully finished conductors, which do not require the development of a robust Wind-and-React technology as is the case for RW Bi-2212. Dealing with a single-filament tape geometry and the significant J_c anisotropy of such conductors are issues that we are just coming to grips with. Thus the path to high fields has been much easier for YBCO coated conductor, as demonstrated by the baton for highest field superconducting magnet recently passing from Bi-2212 to YBCO. A summary of recent progress will be made. Finally we note the recent discovery of high field superconductivity in the layered iron arsenates [1]. These compounds are now clearly a class as can be seen by searching ArXiv over the last month. Our first evaluations show the material to be a two band superconductor with very high Hc2 values that may yet rival the cuprates if T_c continues to double on a monthly basis as has happened in the last month!

*With additional collaboration from Zhijun Chen, David Myers, and Tenming Shen

[1] F. Hunte, J. Jaroszynski, A. Gurevich, D.C. Larbalestier, R. Jin, A.S. Sefat, M.A. McGuire, B.C. Sales, D. Christen, D. Mandrus, "Very High Field Two-Band Superconductivity in $LaFeAsO_{0.89}F_{0.11}$," ArXiv Cond Mat 0804.0485, April 3, 2008