MAR12-2011-020362

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Controlling vortex pinning and vortex phase diagrams of FeAs-based superconductors through particle irradiation and substitution

ULRICH WELP, Argonne National Laboratory

The prominent vortex pinning features of the Ba-122 and Sm-1111 family of pnictide superconductors are presented. For isovalently doped $BaFe_2(As_{1-x}P_x)_2$ we observe the systematic evolution of vortex pinning with increasing P-doping from fishtail behavior to a distinct peak effect near the irreversibility field to a reversible magnetization and Bean Livingston surface barriers. The enhancement of vortex pinning resulting from heavy ion and proton irradiation is shown to arise from delta-Tc-type pinning. These results will be compared to those on optimal doped $BaKFe_2As_2$ and $SmFeAs(O_{1-x}F_x)$. High-energy heavy-ion irradiation induced defects lead to a decrease in the superconducting anisotropy, an increase in the slope of the temperature dependence of the irreversibility line and only small suppression of Tc. In all cases, we see a large enhancement of the critical current following particle irradiation. In particular, on $BaKFe_2As_2$ irradiated to a dose matching field of 21 T with 1.3-GeV Pb-ions, Jc $\sim$ 4 MA/cm^2 at 5 K and in 7 T || c is achieved, comparable to results for YBCO coated conductors at the same temperature and field.

In collaboration with L. Fang, Y. Jia, J. A. Schlueter, H. Claus, C. Chaparro, G. Sheet, A. E. Koshelev, G. W. Crabtree, W. K. Kwok, Materials Science Division, Argonne National Laboratory, Argonne, Illinois, USA; S. F. Xu, Physics Division, Argonne National Laboratory, Argonne, Illinois, USA; H. F. Hu, J. M. Zuo, Department of Materials Science and Engineering, University of Illinois, Urbana, Illinois, USA; A. Kayani, Physics Department, Western Michigan University, Kalamazoo, Michigan, USA; H.-H. Wen, University of Nanjing, Nanjing, China; and N. D. Zhigadlo, J. Karpinski, Solid State Physics Laboratory, ETH Zurich, Switzerland.

This work was supported by the Center for Emergent Superconductivity, an Energy Frontier Research Center funded by the DoE, Office of Basic Energy Sciences (LF, YJ, HC, AEK, CC, GS, GWC, HFH, JMZ), by the DoE, Office of Basic Energy Sciences, under Contract No. DE-AC02-06CH11357 (UW, JAS, WKK) and by the ATLAS accelerator at Argonne (SFZ).