

MICRO-STRAIN IN $Y_{0.5}R_{0.5}Ba_2Cu_3O_{7-x}$ (R=Yb, Tm, Er, Ho, Dy, Gd, Eu, Sm, AND Nd)

Eric J. Peterson, William L. Hults, Michael Simpson, and James L. Smith
Los Alamos National Laboratory Superconductivity Technology Center

For high temperature superconductors to be useful in power applications such as motors and generators, high superconducting current transport needs to be maintained in high magnetic fields. To maintain high critical currents in magnetic fields, it is necessary to pin the magnetic flux lines that penetrate the superconductor. Magnetic flux lines tend to be pinned by defects in the superconductor that may be present naturally, such as twin boundaries and stacking faults, or by artificially introduced defects such as fission tracks or ion beam tracks. It has been reported that novel flux-pinning stacking faults have been introduced into a superconductor of composition $(Y_{0.6}Ho_{0.4})Ba_2Cu_3O_{7-x}$ ¹, presumably as a result of the ionic size mismatch of the ions occupying the Y/Ho site. To carry this further, we synthesized bulk superconductors of composition $Y_{0.5}R_{0.5}Ba_2Cu_3O_{7-x}$ using the lanthanide elements R=Yb, Tm, Er, Ho, Dy, Gd, Eu, Sm, and Nd, as well as a pure $YBa_2Cu_3O_{7-x}$ control sample. Micro-strain was determined by Rietveld analysis, examining three possible models: 1) isotropic micro-strain, 2) anisotropic micro-strain about the c-axis and in the a-b plane, and 3) anisotropic micro-strain about the [103] direction and in the (103) (closest-packed) plane. Results indicate that micro-strain in these compounds is highly anisotropic. Comparisons of the strain-component ratios for each of the anisotropic models indicate that the [103] strain-broadening axis model works best for the $Y_{0.5}Ho_{0.5}Ba_2Cu_3O_{7-x}$ sample whereas the [001] strain-broadening axis model works best for the $YBa_2Cu_3O_{7-x}$ sample and possibly the $Y_{0.5}Nd_{0.5}Ba_2Cu_3O_{7-x}$ sample. Crystallite sizes were found to increase significantly for the smaller lanthanide substitutions (Yb, Tm, Er) and remained at approximately the same size as that of the pure $YBa_2Cu_3O_{7-x}$ control sample for the rest of the lanthanide substitutions.