Phase Equilibria of Ba-R-Cu-O for Coated-Conductor Applications (R=Lanthanides and Yttrium)

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Since the discovery of high T_c superconductors in 1986, extensive research and development activities have continued, leading to the production of many prototype applications. Phase equilibria research provides information critical to the understanding of these materials. Phase diagrams are regarded by materials scientists as "road-maps" for the optimization of processing. In recent years at NIST, we have focused our efforts on phase equilibria studies of high T_c superconductors on the second-generation coated conductors. For the $BaO\text{-}R^2O^3\text{-}CuO_x$ (R=Nd, Sm, Eu, Gd, Y, and Er) systems, phase diagrams have been determined under reduced and atmospheric-controlled conditions to match those for the coated conductor development. A comparison of these diagrams and the crystal chemistry of this series of systems will be discussed. Solid solution study of the $Ba_{2-x}(Nd_{1+x-y}Ry)Cu^3O_{6+z}$ (R=Gd, Y and Yb) and $Ba_{2-x}(Gd_{1+x-y}Yy)Cu^3O_{6+z}$ systems have also been pursued for potential flux-pinning applications. A discussion of the structure/property relations of these materials will be given. We have also investigated the occurrence of low temperature melts in the Ba-Y-Cu-O-F systems as related to the "BaF2" process for long-length coated conductor processing. Our recent results on phase equilibria studies of the Ba-Y-Cu-F-O-H_2O system will be summarized.