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Isotope Effect in High-Tc Superconductors DALE HARSHMAN, Physikon Research Corp., JOHN DOW, Arizona State University, ANTHONY FIORY, New Jersey Institute of Technology — For high-Tc superconductors in which transition temperatures, Tc, are reduced by doping, the oxygen isotope effect (OIE) coefficient in Tc is shown to increase systematically with the pair-breaking rate and with the valence difference between the substituted and native ions. Moreover, the OIE tends to zero as one approaches optimum (or ideal) stoichiometry at which the quality of the superconducting condensate is maximized. In materials with isovalent substitutions, e.g., Sr for Ba or Zn for Cu in YBCO, the small OIE of the parent compound is magnified, owing to pair-breaking disorder. In materials with heterovalent substitutions, e.g., La or Pr for Ba, where carrier densities are necessarily changed, pair breaking induces a much larger OIE. A seminal case is Pr-doped YBCO, where the decrease in Tc observed with Pr doping arises from pair-breaking caused by Pr-on-Ba-site defects. Without the defects, Tc is invariant, providing strong evidence against phononic mechanisms. The fact that Tc drops when Pr substitutes for Ba, but not for Y, indicates that the superconducting hole condensate resides in the BaO layers, where pair-breaking degrades Tc and dramatically increases the OIE. Superconductive pairing modeled on Coulomb coupling between the hole and the electron layers is shown to resolve the shortcomings in electron-phonon interactions.

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Anthony Fiory
fiory@njit.edu
New Jersey Institute of Technology

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