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Superconductivity and Unusual Lattice Dynamics in the β-Pyrochlore Oxides

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Recently two families of pyrochlore oxide superconductors were found: one is α -pyrochlore oxide $Cd_2Re_2O_7$ with $T_c = 1.0$ K[1] and the other is β -pyrochlore oxides AOs_2O_6, where A = Cs, Rb and K, with $T_c = 3.3$ K, 6.3 K and 9.6 K, respectively.[2] The superconductivity of the former compound is of weak-coupling BCS type, while, in the latter compouds, the superconductivity changes from conventional weak-coupling to extremely strong-coupling from Cs to K. In particular, KOs_2O_6 with the highest T_c exhibits various unconventional features, which may be ascribed to anomalous electron-phonon couplings arising from the heavy rattling of the K ions.[3] Possibly related to this, a first-order phase transition at $T_p = 7.6$ K below T_c has been found only for KOs_2O_6. I will discuss on what is the rattling and how it affects the surrounding conduction electrons in the β-pyrochlores.

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[2]S. Yonezawa, Y. Muraoka, Y. Matsushita, and Z. Hiroi, J. Phys.: Condens. Matter **16**, L9 (2004).
[3]Z. Hiroi, S. Yonezawa, Y. Nagao, and J. Yamaura, submitted to PRB.