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Superconductivity mediated by anharmonic phonons: application to β-pyrochlore oxides KAZUMASA HATTORI, HIROKAZU TSUNETSUGU, Institute for Solid State Physics, University of Tokyo — We investigate three dimensional anharmonic phonons under tetrahedral symmetry and superconductivity mediated by these phonons. Three dimensional anharmonic phonon spectra are calculated directly by solving Schrödinger equation and the superconducting transition temperature is determined by using the theory of strong coupling superconductivity assuming an isotropic gap function. With increasing the third order anharmonicity b of the tetrahedral potential, we find a crossover in the energy spectrum to a quantum tunneling regime. We obtain strongly enhanced transition temperatures around the crossover point. The first order transition observed in KOs_2O_6 is discussed in terms of the first excited state energy Δ, and the coupling constant λ in the strong coupling theory of superconductivity. Our results suggest that the decrease of λ and increase of Δ below the first order transition temperature. We point out that the change in the oscillation amplitude $\langle x^2 \rangle$ and $\langle xyz \rangle$ characterizes this isomorphic transition. The chemical trends of the superconducting transition temperature, λ, and Δ in the β-pyrochlore compounds are also discussed.

Kazumasa Hattori
Institute for Solid State Physics, University of Tokyo

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