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Estimation of Electron-Phonon Coupling Constant of Nb and Bi2212 by Modeling the Electron-Lattice Interaction Spectral Function

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In this paper, the value of electron-phonon coupling constant is calculated by modeling the spectral function $\alpha^2(\omega)F(\omega)$ which denotes the electron-lattice interaction. The spectral function is modeled for both Niobium (Nb) and Bi2212 ($Bi_2Sr_2CaCu_2O_{8+x}$).The modeled function is related to electron-phonon coupling strength [1] $\alpha(\omega)$ and phonon density of states $F(\omega)$. Different parameters have been considered during the analysis which includes Debye temperature (Θ) [2], Coulomb interaction on critical temperature (TC) of superconductor etc. Superconductors having different types of coupling limits have been considered for this work and the model function are compared with experimental data. This model function obtained incorporates the effects which explain the deviation of the isotope effect seen in some superconductors from the ideal value of the coupling strength (0.5). The modeled function obtained is found to follow the experimental data closely. Using the Eliashberg relation [3], the electron-phonon coupling constant is calculated from the modeled spectral function. The calculated value is compared to other theoretical and experimental values and found to be consistent.

[1] B. J. Dalrymple and P. Santhanam, "Approximating the Electron-Phonon Coupling Constant in Superconductors from Thermodynamic Data," Journal of Low Temperature Physics, Vol. 57, Nos. 3/4, 349, 1984.
[2] Andrei Marouchkine, "Room-Temperature Superconductivity," Cambridge International Science Publishing, 2004.
[3] Charles P. Poole, Jr. "Handbook of Superconductivity," Academic Press, 2000.
[4] Michael Tinkham, "Introduction to superconductivity," McGraw-Hill, Inc.
[5] Samir S. Soliman, M. D. Srinath,1998. "Continuous and Discrete Signals and Systems," Prentice Hall of India , 1996.
[6] P.G. De Gennes, "Superconductivity of Metal and Alloys," Westview Press, 1999.
[7] John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principle, Algorithms and Applications," Prentice Hall International Inc. 1996.