ABSTRACT

The study comprises an electron-Cooper pair interaction system in a YBCO123 material in an attempt to unearth the mechanism behind high temperature superconductity. Superconductivity is the state of an object characterized by close to zero dc electrical resistance, hence infinite conductivity of electrical resistance by the material, when the temperature of the material is lowered below the critical temperature (T_C) of the material in a zero magnetic field strength. YBCO123 has been used to study the thermodyna. The dependence of superconductivity on the critical temperature has been used to find other thermodynamic properties such as the energy of a system, entropy, specific heat among others. The microscopic theory of superconductivity by Bardeen, Schrieffer and Cooper (BCS theory) was able to explain the pairing mechanism in low temperature superconductivity (LTSC) which occurs at a temperature of 30K and below. High temperature superconductivity (HTSC) cannot be explained using the BCS theory. So far, the models that have been developed cannot satisfactorily explain HTSC. In this study, a three electron model, which had earlier been studied using the method of second quantization, is now probed using Bogoliubov-Valatin transformation with the aim of improving its accuracy. It was proposed that the Cooper pair interact with an electron in a yttrium-based cuprate, YBCO123. The Hamiltonian for the system was first expressed in terms of annihilation and creation operators. Using the Hamiltonian at the equilibrium the energy, specific heat, electronic specific heat, and entropy of the system in YBCO123 were determined. A tool for generating the tables of values and and that of plotting graphs, both in the MATLAB computer software, was used in calculating the energy, entropy, specific heat, and Sommerfeld's coefficient for the system of Cooper pairs interacting with electrons in the YBCO123. The total energy, specific heat and entropy of the system at a T_c of 93K were found to be 2.173meV, $4.069 JMol^{-1}K^{-1}$ and $3.056 x 10^{-22} JK^{-1}$ respectively. In principle, the results obtained by BVT were the same as those obtained by the second quantization method.