World Academy of Science, Engineering and Technology
International Journal of Physical and Mathematical Sciences
Vol:19, No:01, 2025

Thermodynamic and Magnetic Properties of Heavy Fermion UTE_2 Superconductor

Authors : Habtamu Anagaw Muluneh, Gebregziabher Kahsay, Tamiru Negussie

Abstract : Theoretical study of the density of state, condensation energy, specific heat, and magnetization in a spin-triplet superconductor are the main goals of this work. Utilizing the retarded double-time temperature-dependent Green's function formalism and building a model Hamiltonian for the system at hand, we were able to derive the expressions for the parameters mentioned above. The phase diagrams are plotted using MATLAB scripts. From the phase diagrams, the density of electrons increases as the excitation energy increases, and the maximum excitation energy is equal to the superconducting gap, but it decreases when the value exceeds the gap and finally becomes the same as the density of the normal state. On the other hand, the condensation energy decreases with the increase in temperature and attains its minimum value at the superconducting transition temperature but increases with the increase in superconducting transition temperature (TC) and finally becomes zero, implying the superconducting energy is equal to the normal state energy. The specific heat increases with the increase in temperature, attaining its maximum value at the TC and then undergoing a jump, showing the presence of a second-order phase transition from the superconducting state to the normal state. Finally, the magnetization of both the itinerant and localized electrons decreases with the increase in temperature and finally becomes zero at TC = 1.6 K and magnetic phase transition temperature T = 2 K, respectively, which results in a magnetic phase transition from a ferromagnetic to a paramagnetic state. Our finding is in good agreement with the previous findings.

Keywords : spin triplet superconductivity, Green's function, condensation energy, density of state, specific heat, magnetization
Conference Title : ICCMP 2025 : International Conference on Condensed Matter Physics
Conference Location : New York, United States
Conference Dates : January 30-31, 2025