Study the Phenomena of Superconductivity and its Applications

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Abstract: *Superconductivity is a fascinating physical phenomenon characterized by the complete absence of electrical resistance in certain materials at extremely low temperatures. This mini project aims to investigate the phenomena of superconductivity and explore its potential applications by conducting experiments with different superconducting materials. The project begins with a comprehensive review of the principles and theories underlying superconductivity, incl[11]uding the BCS theory and the Meissner effect. Key concepts such as critical temperature (Tc), critical magnetic field (Hc), and critical current density (Jc) will be explained.*

The experimental part of the project focuses on the synthesis or acquisition of various superconducting materials with different critical temperatures. Techniques such as solid-state synthesis, chemical vapor deposition, or high-pressure synthesis may be employed to obtain these materials. Once the superconducting samples are obtained, their critical temperatures will be determined using appropriate measurement techniques, such as resistivity or magnetic susceptibility measurements. Furthermore, the project aims to investigate the properties and behaviors of superconducting materials in different experimental setups. This may include exploring the effects of magnetic fields on the superconducting state, studying the phenomenon of flux pinning, and examining the behavior of superconducting materials in the presence of external perturbations. Additionally, the project will explore the applications of superconductivity in various fields, such as energy transmission, magnetic levitation, and quantum computing. The experimental investigation will involve designing and constructing simple devices to demonstrate the practical applications of superconducting materials. For example, a small-scale superconducting magnet or a superconducting quantum interference device (SQUID) could be built to showcase the unique properties and benefits of superconductivity.

Through this project, students will gain hands-on experience with superconducting materials, develop skills in experimental techniques, and deepen their understanding of the principles and applications of superconductivity. The results and findings from the experiments will contribute to the existing body of knowledge on superconductivity and inspire further research in this exciting field.

Keywords: superconductivity, critical temperature, magnetic field

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DOI: 10.48175/568

ISSN
2581-9429
IJARSCT

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DOI: 10.48175/568

ISSN
2581-9429
IJARSCT

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