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How Reliable is the Cuprates System to Recent Technology?

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ABSTRACT

The emergence of cuprates as a high Tc superconductor gave high hopes in the discovery of a room temperature superconductor. It is almost three decades and the highest critical temperature attained on the cuprates is about 135K. A brief overview was conducted on the progress made so far on the cuprates. A mathematical approach was used to design a formula which could determine the experimental results of critical temperature of versed cuprates superconductors. The result of our findings shows that the possibility of attaining the experimental room temperature cuprates superconductor seems very narrow. The study recommended an elaborate approach on the hybridization of cuprates for future research. Hence, there is possibility of having cuprates with wide engineering application.

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1. INTRODUCTION

Since the emergence of the concept of superconductivity by Kamerlingh Onnes in 1911[1], numerous scientific research work were conducted to explain the theory of superconductivity. Joseph John Thompson [2] made a proposal that superconductivity was due to fluctuating electric dipole chains while Einstein [3] explained that the theory of superconductivity was due to molecular conduction chain which was independent on non-interacting electrons in solids. In 1928, after the formulation of quantum mechanics, Heisenberg [4] and Felix Bloch [5] made their contributions by introducing the theory of magnetism and the theory of electrons in crystals respectively. Bloch's second theorem on superconductivity - coupled spontaneous currents and coherent quantum motion of electrons, was proved wrong by David Bohm [6]. Landau [7,8] proposed the free energy expansion of antiferromagnets and the theory of phase transition. Léon Brillouin [9] supported Bloch's first theorem where he claimed that superconductivity was a metastable state. Walter Meissner and Robert Ochsenfeld demonstrated that the magnetic flux is expelled from a superconductor regardless of its state. This idea was corroborated by the London theory of penetration depth [10]. Werner Heisenberg gave a new dimension to the theory of superconductivity by investigating the bound states of the Fermi energy. This theory was vehemently criticized by Fritz London [10], he proposed that superconductivity was due to vibrations of the crystal lattice which affirmed clearly that a superconductor in a coherent quantum state are macroscopic. Fröhlich [11] discovered that the vibrations of the crystalline lattice engendered a net attraction between electrons. He suggested that a likely cause of superconductivity. In 1954, Fröhlich proposed the high temperature superconductor. In 1957, Bardeen, Cooper, and Schrieffer [12] came out with the microscopic (BCS) theory – based on conceptual and mathematical foundation for conventional superconductivity. The BCS theory actually explained the mechanism for the convectional superconductivity. Unarguably, one of the early initiators of the microscopic treatment of convectional superconductor is the BCS theory. Though its progress was short-lived as other types of high-temperature superconductors emerged. The microscopic treatment of superconductor on its own is a valid theory.