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Ultra-Conductors-The Future of Energy Transmission

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Abstract:-The purpose of this paper is to provide the real information about the Ultra-**Conductors** ***to improve the transmission capacity of power system. The resistance offered by these conductors is zero or negligible, It means there is no loss of energy in the transmission.***

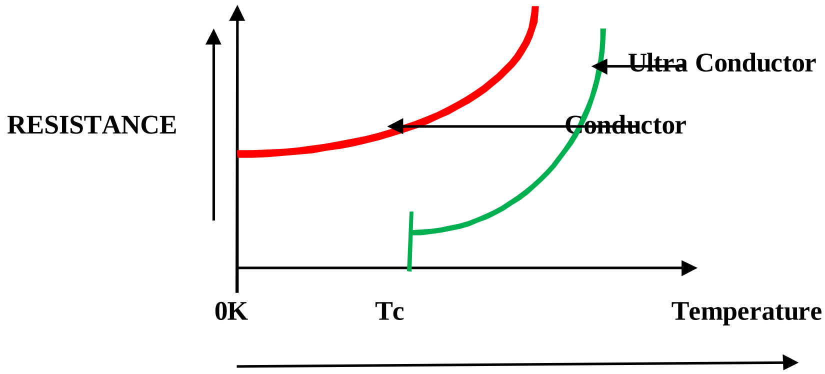
I. INTRODUCTION

The overall economic development of any country depends upon the electrical power. The main components of electrical power system are generating stations, transmission lines and distributed systems. The source and load stations are connected with the help of transmission lines. The transmission system of large area such as (State Transmission System) is termed as Grid. In distribution system the loads of a particular area are also connected to transmission lines. So, Transmission system plays a vital role in power transfer. The transferred power cannot be utilized in electrical form, so it is to be converted in the form of heat, light or mechanical energy. During these transformations of energy from one form to another there is enormous amount of heat loss. The main reason behind heat loss is resistance, but when there is no resistance then no heat loss and transmission capacity of conductor increases. It can be done by the use of Ultra conductors which follows superconductivity principle.

II. SUPERCONDUCTIVITY

The superconductivity is the phenomenon in which the conductor losses its complete resistance when kept at temperature 100 º above absolute zero (-273 ºK), and this temperature is also known as Characteristic Critical Temperature .This phenomenon was discovered by Dutch physicist; H.K. Onnes in 1911.The conductors which shows superconductivity are called Ultra conductors. The rate of electrical conduction increases with decrease in temperature. When a current is passed through pure mercury wire with gradual temperature decrement, It was observed that there was no resistance at a temperature 4.2Kelvin.The Superconductors are also known as Ultra Conductors, These conductors have capacity to conduct electricity with negligible energy loss. The electronic activity inside a superconductor is entirely different. The resistance provides obstruction to electrons and obstructions offered due to collision of electrons with impurities and lattice framework. But the movement of superconducting electrons through the obstacle is quite different. The electrons inside superconductors travel in such a way that, they pass without interruption through the complex lattice. As there is no interruption, so there is no collision and creates no friction. It results in transmission of electricity without loss in the current and energy. Now the theory behind superconductivity.

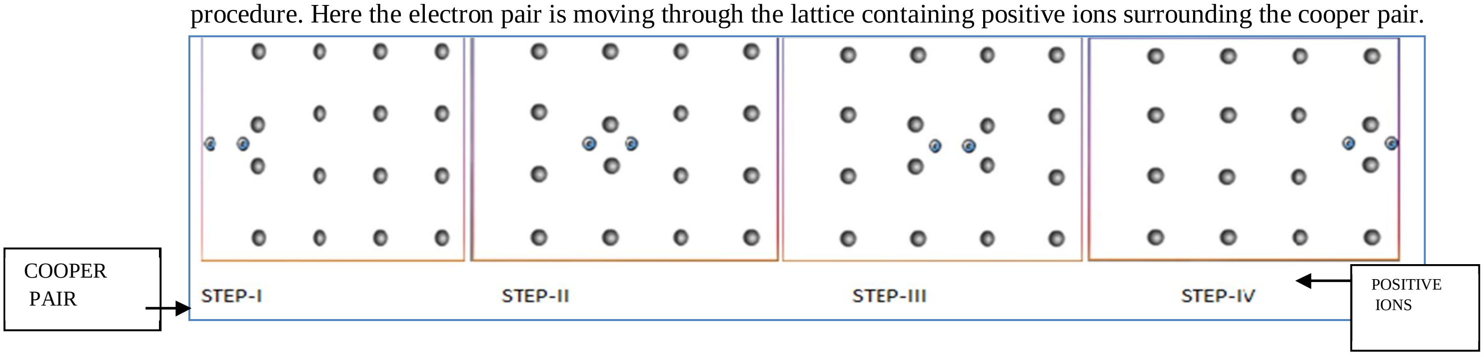
The graph of normal conductor v/s Ultra conductor is drawn below:-



III. BCSTheory

The contribution of Bardeen, Cooper and Schrieffer explains the superconductivity at a temperature close to the zero temperature and cooper discovered that atomic lattice vibrations were responsible for unifying the entire current; the electrons are forced to pair up in teams that could easily pass through the hurdles which are responsible for resistance in conductor.

This theory successfully represents the attraction of electrons to one another through crystalline lattice structure, although electrons have same charge. When the oscillation of lattice takes place in positive and negative regions, the electron pair is pulled together and pushed aside without collision. Here, the electron pairing is favorable as it has the tendency of putting the element into lower energy state. Once they combine together in pair, they move in well defined manner through ultra conductors. Below critical temperature, the paired electrons form a macroscopically occupied single quantum state. Figure below represents the complete procedure. Here the electron pair is moving through the lattice containing positive ions surrounding the cooper pair.



There are three important factors which define the superconducting state:-

A. Critical Temperature (T):-It is the maximum temperature at which superconductivity occurs in a material. Below this transition temperature T the resistance of a particular element becomes equal to zero.

B. Critical Magnetic Field (Hc):-It is the value of applied field above which the superconducting state is changed to non-superconducting state.

C. Critical Current Density (Jc):-It is the highest value of current per unit cross-sectional area that can be carried by superconductor without resistance.

IV. MEISSNER EFFECT

The levitation of a magnetic material above a superconductor which is cooled below characteristic critical temperature is called Meissner Effect. Here, the surrounded magnetic field does not penetrate the superconductor. This creates a induced current creates a magnetic forces that prevents attraction of two materials, And the magnet gets levitated above superconductor. The above effect can be utilized for the many industrial applications.

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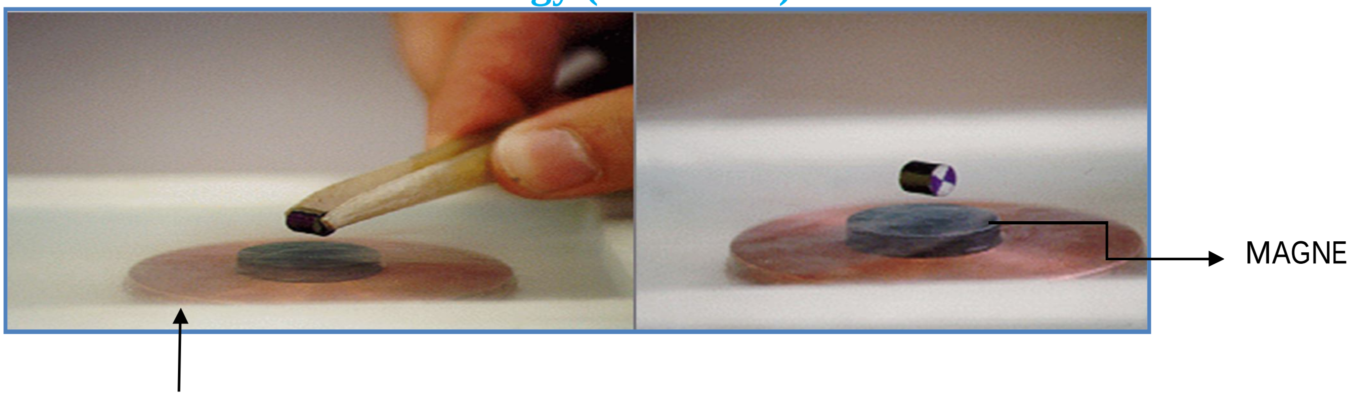
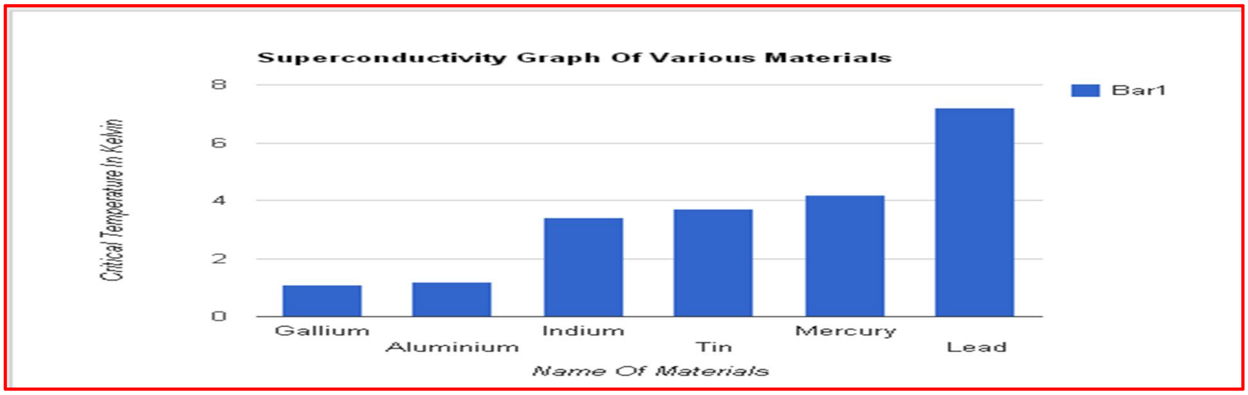


Fig:-The Meissner Effect

The superconductivity behaviors of certain material are shown below with their characteristic critical temperature:-



V. APPLICATIONS OF ULTRA CONDUCTOR

A. Medicine
B. Theoretical and Experimental Science
C. Military
D. Transportation
E. Power Production and Power Transmission

VI. SUMMARY

As the demand of power is continuously increasing, so we have to select the conductor which provides power with negligible losses .Superconductivity is totally dependent upon cooper pair formation, This cooper pairs prevents the collision of electrons into various imperfections which further results in formation of resistance. The cooper pairs are formed with the help of Superatoms; These Superatoms when properly arranged in the form of long chain along a material substrate, electricity can flow through without any restrictions. So Superconductors or Ultraconductors can be the conductor of future. The research is going on to produce superconductivity phenomenon even at high temperature, as there is change in quantum state even in high temperature. So, finally modification in components of power system to improve its efficiency can only be done by the application of Ultra conductors.

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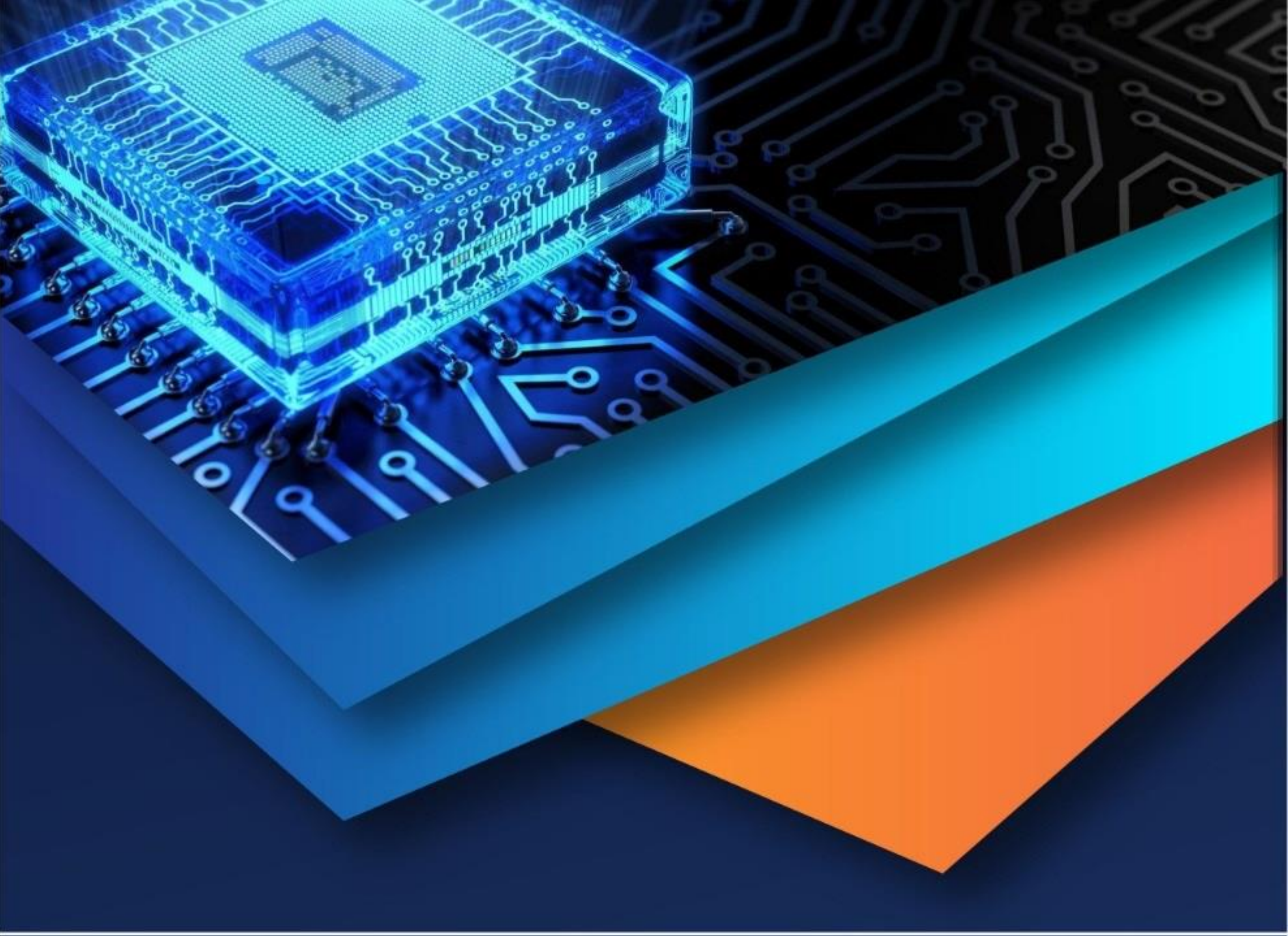

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