In Search for High-Temperature Superconductors

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Abstract

Schrödinger's basic ideas in life's phenomenon interpretation are used here in a humble attempt to give a very general explanation of high-temperature superconductivity phenomenon. As a logical consequence of the reasons discussed here, a key concept of aperiodic crystal is shown be potentially able to allow one to grope a direction in either searching for ready-made high-temperature superconductors or manufacturing new ones.

KEYWORDS: Schrödinger, Superconductivity, Aperiodic.

Schrödinger's ideas about life

Ideas that are about to be briefly discussed here are taken from elsewhere [1]. In that treatise Schrödinger clearly points on an astonishing feature of any living entity to maintain its functioning by postponing an arrival at final destination point, which is a state of thermodynamical equilibrium (*i.e.* death), via the process of production *"order from order"*, meaning consumption of highly ordered protein molecules [1]. Schrödinger compares highly ordered and well organized functioning of any living organism with the work of mechanical clock. Then, following Planck's terminology, Schrödinger includes living and clockwork to the Realm of *dynamical* processes [1]. Dynamical processes are running with no apparent disturbances caused by statistical process of heat motion of atoms/molecules. Obviously, any system would have behaved as a dynamical one once the heat motion is turned off, which would have happened at absolute zero. However, absolute zero is unreachable due to Nernst's Theorem [1]. For this reason, one may legitimately speculate that systems, which behavior is dynamical at Room temperature, have already reached their "own" absolute zero temperature or the Temperature of Zero-Heat-Motion-Effect (ZHME). Finally, Schrödinger concludes that any living organism behaves dynamically, meaning his/her ZHME temperature is far above absolute zero, because of *aperiodicity* of the crystals his/her chromosomes are made of.

High-Temperature Superconductivity

Anyone of intelligent mind would have agreed at this point that a High-Temperature Superconductivity phenomenon must be considered as a *dynamical* one. Indeed, electric resistivity is a measure of disturbances to a direct flow of electrons. The disturbances are caused by heat motion of structural elements – atoms or molecules. For this reason, hypothetically, any crystalline material with free electrons should have a zero electric resistivity at absolute zero. Miraculously, there are materials with zero electric resistivity at temperatures

high above absolute zero. Thus, following a complete analogy with the previous train of thoughts concerning life phenomenon, one may conclude that a zero electric resistivity materials have already reached their own ZHME temperature. Regular structure of any usual *periodic* crystal maximizes disturbing action of a heat motion by allowing heat motion to form regular patterns – standing waves [2]. Therefore, in order to have none zero ZHME temperature (*i.e.* to be a high-temperature superconductor), a candidate material has to be an *aperiodic* crystal (*i.e.* of regular structure with no translational symmetry) to suppress a disturbing heat motion (*i.e.* to make formation of heat motion standing waves impossible).
In other words, highly ordered structures with no translational symmetry must be targeted as the most expected ones to possess high-temperature superconductivity.

Concluding Remarks

Two major classes of the alleged high-temperature superconductors one may envision here.

(I) Ready-Made Structures

Quasycrystals - discovered and described by Shechtman [3].

Individual Perfectly Lengthed Single-Walled Nanotubes (PLSWNT's)

PLSWNT's are nanotubes, lengths of which are within the sizes of their translational unit cells. It should be noted here that maximal value of aspect ratio for Perfectly Lengthed Single-Walled Carbon Nanotubes is approximately 5, thus, making short and ultra short SWCNT's targets for superconductivity hunting [4].

Individual Multi-Walled Nanotubes (MWNT's)

In these objects translational symmetry is supposed to be broken by mutually shifted shells of well-ordered structural elements.

3D and 2D bundles comprised of irregularly stacked nanotubes of different diameters, with high-temperature superconductivity expected to be in the directions, normal to the long axes of the bundles.

(II) Modified Structures

Translational symmetry of these materials is supposed to be artificially broken, using any of suitable technological means, for instance, nanolithography, encapsulation, intercalation etc.

References

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