

Novel promising applications of boron-based nanotubes and 2D crystals

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Nanotubes (NTs) are commonly accepted to have unique electronic, mechanic, optic and other properties. The reason is a phase transition connected with change symmetry $3D \rightarrow 1D$ under reducing of tube diameter up to nanolevel - a nanotube become a quasi-1D quantum unit, but macroscopic in length. Furthermore a packed 2D lattices and ordered bundles or ropes of NTs is expected to be a more unique crystals of top importance as being both a quantum and macroscopic crystals with extended inner porous surface.

2D Lattice of superconducting noncarbon NTs was at first suggested as an ideal superconductor with record critical temperature T_c [1,2]. Mechanism of superconductivity was proposed on base of a whispering mode of phonon vibration which is shown to be responsible for a strong enhancement of electron-phonon interaction and for an increase of T_c and J_c . Coherent and low attenuated vibrations of all atoms pairs on diameter-opposite walls of NTs induce the coherent states of their nearest electrons pairs with opposite impulses $(-k, k)$ that provide an ideal conditions for Cooper pairing and Bose-Einstein condensation.

Superconducting properties of NTs are reviewed, especially a recent discovery of new hexagonal MgB_2 superconductor with $T_c=39$ K by Finnemore et al., and some indications of a possible room- T_c superconductivity with $T_c=400$ K in carbon NTs bundles by Zhao & Wang. Four routes were proposed to synthesize such the MgB_2 record nanotubular superconductors.

Vibrative properties of NTs are reviewed, especially their peculiar whispering gallery modes, such a high frequency breathing A_{1g} , silent E_{1u} and squash E_{2g} modes. In addition to their low attenuation, the BN-nanotubes posses a charge transfer and the piezoelectric properties as a result. Hence this NTs may serve as powerful electroacoustic transducers in giga- and tera-hertz range. Accounting the propagation of an ultrasound is possible in crystals only, we can suggest a hypersound generator and detector on base of BN

nanotube with SiC core, that was synthesized recently.

2D nanotubular crystals promise to be the best photonic crystals, collar cells, effective gas membranes, etc., that allow us to call them as miracle-crystals.

1. V.V. Pokropivny. Room- T_c superconductivity on whispering mode in quasi-1D com-posite of superconducting nanotubes. Is it possible? // J.Superconductivity 13, 607 (2000)
2. V.V. Pokropivny. Composite on base of 2D nanotubular lattice as ideal high- T_c superconductor // Physica C 351, 71 (2001).