Chrysotile, a Naturally Occurring Nanotube Material

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The potential of nanosized tube-shaped materials range from the use as wires, wire-templates, microreactors, hydraulic tubes, gas storage devices and optical devices among others. A naturally occurring, nanosized, tube-shaped phase is the silicate mineral chrysotile, $Mg_3Si_2O_5(OH)_4$. The structure of chrysotile consists of enrolled sheets composed of a layer of tetrahedrally coordinated silicon cations and a layer of octahedrally coordinated magnesuim/aluminum cations. It is one of the rare natural materials with five-fold symmetry.

Chrysotile is common in metamorphosed ultramafic rocks and easy to extract in large quantities. Like for carbon nanotubes, different enrollment schemes (cylindrical, helical etc.) are known. The chrysotile nanotubes differ from the carbon nanotubes in some important physical parameters e.g. they are non-conducting and their length can reach the cm-range.

A drawback for the application of these natural nanotubes is, that chrysotile is carcinogenic. It is one of the minerals that are classified as asbestos material. Research is, therefore, oriented in different directions: 1. the study of the physical and chemical properties of chrysotile in order to tailor replacement materials (membranes used in water electrolysis, fiber enforced concrete etc.), 2. the behavior of chrysotile fibers in the environment and during the handling of asbestos containing materials, 3. the search of new applications for chrysotile nanotubes, requiring only small quantities. The structure of chrysotile and projects in all three research fields will be presented.

Keywords: nanotube, asbestos, five-fold symmetry