# Synthesis, characterization, and mechanical stability of filled and empty carbon nanotubes

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Carbon nanotubes exhibit an extraordinary mechanical strength, which is due to the carbon atom network based on the strong covalent bonds between the $sp^2$ orbitals. Despite their high mechanical strength, it is theoretically predicted that single-walled carbon nanotubes (SWCNTs) undergo structural deformations above a certain critical pressure $p_c$, namely a reversible change from the circular cross section to an oval or elliptical shape. At high pressures, the collapse of SWCNTs is expected.

The mechanical stability of SWCNTs can be significantly influenced by the relative orientation of the nanotubes within an assembly. Furthermore, it was claimed that filling the SWCNT with another tube (so-called double-walled carbon nanotubes, DWCNTs) or with argon results in the stabilization of the outer tube against collapse, whereas fullerene or iodine filling (so-called peapods) leads to the destabilization of the nanotube.

In my talk I will discuss the mechanical stability of SWCNTs, peapods, and DWCNTs based on their optical response under hydrostatic pressure. First, I will briefly describe the synthesis of the materials and their characterization by HRTEM, Raman and IR spectroscopy. Then, I will present the alterations of their electronic properties under mechanical load, as obtained by pressure-dependent transmission measurements in the near-infrared and visible frequency range. The results will be compared to earlier results under pressure obtained with different experimental techniques.