Master thesis

Carbon Nanotube and Metal Composite technology for electronics cooling applications

Supervisor: Andreas Nylander (andreas.nylander@chalmers.se)

Lab: Electronic materials and systems laboratory (EMSL), MC2, Chalmers

Examiner: Professor Johan Liu (johan.liu@chalmers.se)

Project description

Carbon nanotubes (CNT) have since their discovery 25 years ago inspired scientists with their extreme thermal mechanical and electrical properties. The high thermal conductivity is theoretically predicted due to the large phonon mean free path, a consequence due to their strong sp2 carbon structure. CNTs are a good candidate for use in future electronic devices for thermal management, interconnects and transistors. Unfortunately, most carbon nanomaterials suffer from high contact resistances, which have hindered them from being used in commercial products.

Metals are commonly used in thermal management due to their high thermal conductivity and relative low cost. Their mechanical properties however are lacking with reliability issues due to crack propagation as a result. By incorporating a CNT fiber into a metal such as Indium or SAC (SnAgCu), crack propagation can be repressed. This would result in a material with exceptional thermal and mechanical properties.

In this project, carbon nanotubes will be synthesized by the means of photolithography, e-beam deposition and chemical vapor deposition. The nanotubes are then to be modified into the desired structure and infiltrated using typical metal alloys used in thermal management. Various equipment will be utilized in order to evaluate the quality of the materials in terms of mechanical properties as well as thermal and mechanical performance. This includes SEM, Raman and XPS for structural and chemical composition, joule heating and flash method for thermal performance as well as shear and tensile testing for mechanical behavior.

Students with a background in nanotechnology, physics, chemistry or equivalent are preferred.

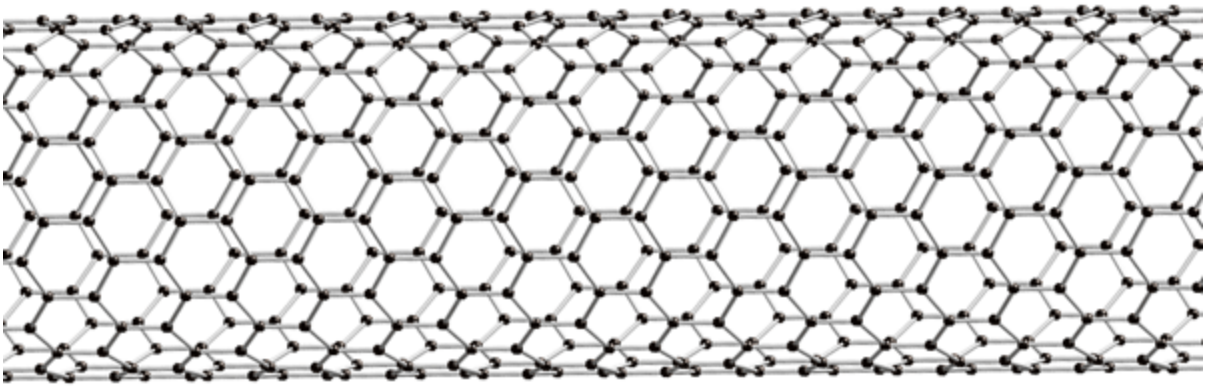

Figure: The sp2 structure of a carbon nanotube