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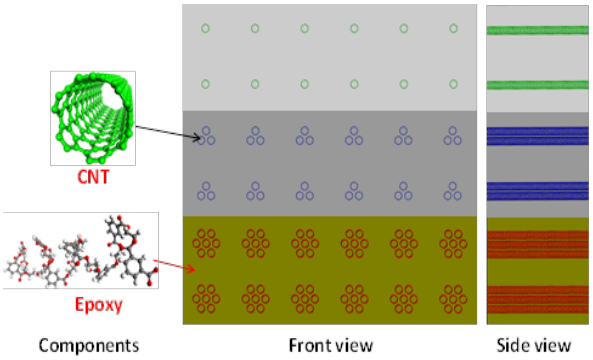
Putting carbon nanotubes through their paces

Professor Yang Xiang and Dr Qinghua Zeng from the School of Computing, Engineering and Mathematics have received a Discovery Projects grant from the Australian Research Council to investigate the properties of carbon nanotubes when added to other materials to improve their strength. The aim of the research is to clear up confusion about the performance of carbon nanotubes within a structure, and determine how they can be prepared for use in "functionally graded" materials. At least two PhD students will assist with this research; one is to investigate the properties of carbon nanotube reinforced composite material at the nano/micro scale, and the other is to study the mechanical behaviours of functionally graded nanocomposite structures.

'Combinations of different substances that perform better together than alone can save time and money, and provide a better engineering material to support weight, conduct electricity, or absorb heat', Professor Xiang says. 'These composite materials can be created out of almost anything and polymer composites are becoming more popular. However, polymer composites alone may not be able to perform in every environment, but embedding carbon nanotubes within them can help increase their strength and versatility. The carbon nanotubes can even be dispersed unevenly throughout a composite, creating a "functionally graded" structure that reacts to heat or load differently to a structure with uniform distribution of the nanotubes.' This research will explore the properties and behaviours of carbon nanotube-reinforced polymer composites (CNTRPCs) and their functionally graded structures using numerical modelling and simulations.

The first stage of the project will see researchers create molecular models of carbon nanotubes in an epoxy composite, and run simulations on its performance. The simulations will evaluate various size and diameter of nanotubes in terms of their loading capacities. The next stage will use the results from the simulations to study the material properties of CNTRPCs, and the final stage will use structural analysis techniques to investigate the mechanical responses of functionally graded CNTRPC structures under different loading conditions.



Functionally graded structure of a CNTRPC

CNTRPCs have a wide range of scientific and engineering applications, and their use reinforcing structures and mechanical parts could greatly improve the durability of buildings, tools and aerospace crafts. A thorough understanding of the mechanical behaviours of functionally graded CNTRPC structures would enable Australian industries to be highly competitive in the field of advanced materials and structures.

Project Title: Material properties and mechanical behaviours of carbon nanotube-reinforced composite structures
Funding has been set at: $286,000
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October 2015