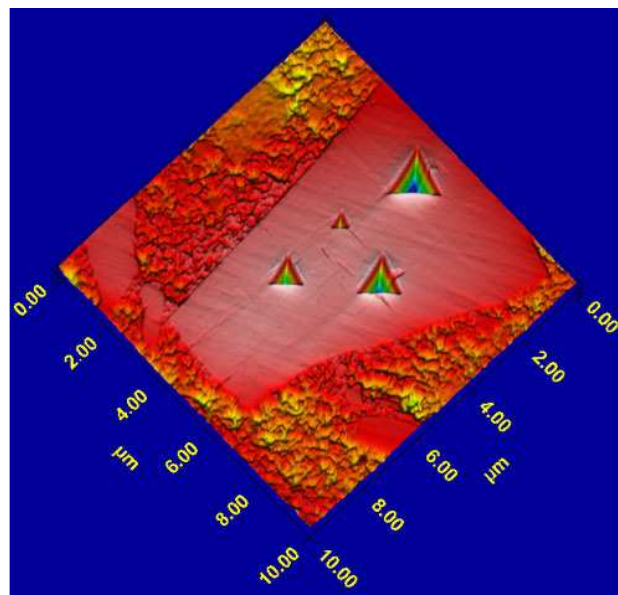


## Theoretical investigation of nanoindentation response of nano-composite materials

--- proposed by Dr Wenyi Yan, senior lecturer of Mechanical and Aerospace Engineering Department, Monash University

In a nanoindentation test, a diamond indenter is pressed into the surface of a specimen with the depths ranging from a few hundred nanometers to micrometers. The curve of the indentation force versus the indentation depth can be recorded, which can be used to extract the specimen's mechanical properties, such as Young's modulus and hardness. Due to its simplicity and convenience, nanoindentation test becomes a popular experimental method to study the mechanical behaviors of materials at small scale. On the other hand, nano-composite materials, such as carbon-nano-tube or nano-clay reinforced polymers, are attracting much research attention due to their promising application future. Nanoindentation test has been applied to study the mechanical properties of nano-composite materials. However, to correctly apply this method, one must understand the relationships between the indentation curve and the mechanical properties of the specimen. The relationships developed by Oliver and Pharr for monolithic materials have been often applied directly in nano-composite materials without any corrections.

In this proposed research, theoretical analysis and the finite element simulations will be applied to find the relationships between the indentation response and the mechanical properties of nano-composite materials so as to develop nanoindentation method to calibrate the properties of nano-composite materials. Nanoindentation tests on nano-composite materials will be carried out to verify the developed method. Prof. George Simon, an nano-composite expert and the Head of Material Engineering Department, will co-supervise the student on this research. We are looking for an H1 or H1 equivalent student to work on this project as his/her PhD study. This student should have a sound knowledge on solid mechanics and is interested in computational simulations.



Ceramic Matrix Composite ([www.hysitron.com](http://www.hysitron.com))

The high resolution of the in-situ imaging and accuracy of indent positioning allows individual indents applied at increasing loads to be applied on a particle within this composite matrix. This study enabled

the mode of failure to be identified for each particle and the maximum load before catastrophic failure to be determined.