Summer Research Program 2011/2012

# *Smart Materials and Adaptive Structures*

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## Objective

*This project will investigate the effect of crystallographic orientation on deformation response of 'Nitinol' alloys.*

## Description

This project takes two fairly simple concepts – strain engineering and pseudoelasticity – and combines them in a novel way which opens up new ways to use pseudoelastic materials, potentially cheaper ways to manufacture artefacts currently made from pseudoelastic materials, and certainly improved understanding of the behaviour of pseudoelastic materials as part size and microstructural scale converge.

Strain-engineering is the enhancement of material properties by controlling the local strain in a material, and the properties that are controlled can be either mechanical or physical. Strain engineering can be designed around reproducible and repeatable mechanical response and strain-engineered metals can include TRIP and TWIP steels, 'shape-memory" alloys, 'pseudoelastic' materials, and auxetic materials. This project focuses on Nickel-Titanium (NiTi) alloys which can exhibit shape-memory and pseudoelastic behaviour. NiTi alloys are currently the most widely used shape memory alloys because of the ability to tailor their properties by thermomechanical treatment. NiTi alloys are used in medical applications for devices such as stents, medical tools, and dental drills, but interest is growing in their application to micromechanical systems, biomimetic structures as well as in bulk applications, such as bracing of structures to control their dynamic response during fire and seismic loading. Although the shape memory and pseudoelastic effects have been known since the 1930s and exploited since the 1960s, the focus has been largely on the phase transformation behaviour in isolation from the crystallographic texture of the material. Coupling of these and understanding the resultant effects is the key to strain engineering this class of materials.