Modelling of evolution of martensitic microstructures in shape memory alloys

Shape memory alloys belong to the group of smart (or functional) materials. The interesting effects, such as the shape memory effect and pseudoelasticity, observed in these materials are associated with a reversible martensitic phase transformation induced by temperature changes of by mechanical loading. At the micro-scale, the martensitic transformation is accompanied by formation and evolution of martensitic microstructures. Modelling of these phenomena constitutes an important and interesting research topic.

The research topic proposed for this PhD project is concerned with modelling of evolution of martensitic microstructures. The goal is to gain deeper understanding of the mechanisms responsible for the shape memory effects as well as their predictive modelling with account for interfacial energy and size effects. This will be achieved by applying the micromechanical approach (i.e. consideration of the mechanisms active at different spatial and temporal scales combined with a suitable scale transition method) and multiscale analysis

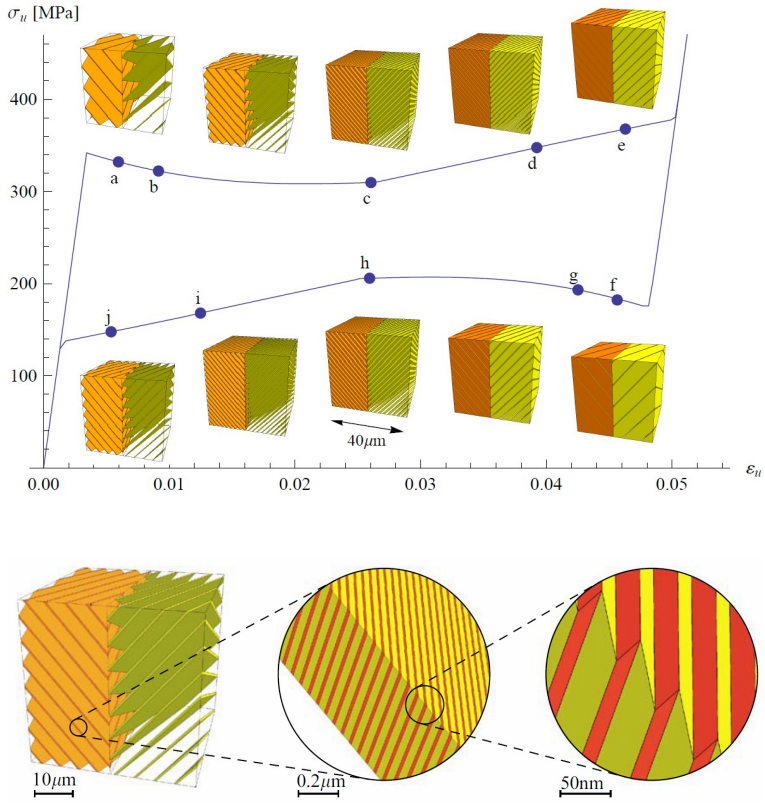

Figure: Evolution of microstructure in a pseudoelastic CuAlNi alloy (modelling results [1]).

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[1] H. Petryk, S. Stupkiewicz and G. Maciejewski (2010). Interfacial energy and dissipation in martensitic phase transformations. Part II: Size effects in pseudoelasticity, *Journal of the Mechanics and Physics of Solids*, vol. 58, 373-389.

[2] S. Stupkiewicz and H. Petryk (2010). A bi-crystal aggregate model of pseudoelastic behaviour of shape-memory alloy polycrystals, *International Journal of Mechanical Sciences*, vol. 52, 219-228.

[3] S. Stupkiewicz and H. Petryk (2013). A robust model of pseudoelasticity in shape memory alloys, *International Journal for Numerical Methods in Engineering*, vol. 93, 747-769.