Extremely anisotropic mechanics of modulated martensites exhibiting twin supermobility

Hanuš Seiner, Institute of Thermomechanics, Czech Academy of Sciences, Prague

Non-linear elastic behavior of ferroelastic martensites (also known as shape memory alloys) is typically described by a multi-well energy landscape, at which the locations of individual minima represent stable or quasi-stable crystal structures, and the shapes of the minima are determined by anisotropic elastic coefficients. The generally accepted Landau theory assumes that the energy landscape can be well approximated using low-order polynomials, with saddle points determining easy paths between the individual minima. As a result, the quasi-stable crystal phases tend to be elastically soft with respect to straining in directions towards the saddle points, which means towards other energy wells.
In this talk, I will show a peculiar exception from this rule, which is the extremely anisotropic behavior of modulated Ni-Mn-Ga martensite. The modulated phase can be fully described as monoclinic martensite using the Cauchy-Born rule, but its elastic response is dictated by finer-lengthscale lamination, called structural modulation. In the case of Ni-Mn-Ga 10M martensite, the modulation is extremely compliant, giving rise to anisotropic behavior not observed for any other metallic material before. It will be shown that this behavior is closely related to the stunning phenomenon of twin supermobility, and how this behavior can be assessed experimentally.