Ni_2MnGa shape memory alloy studied by x-ray diffraction measured *in-situ* in tension

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Ni_2MnGa is a widely studied system due to its interesting properties related to the magnetic shape memory phenomena. The compounds based on Ni-Mn-Ga system have also an interesting application potential as the micropumps or the sensors [1, 2]. Their shape memory properties are connected to the martensitic transformation, during which the high-temperature cubic phase (austenite) undergoes a transformation to the low-temperature phase with a lower symmetry (martensite) [3].

As a consequence of a large magnetic anisotropy and a high mobility of the internal regions (so called twin variants/twinned domains) magnetically induced reorientation could be achieved - it is more energetically preferable to reorient the whole unit cell than to rotate magnetic moments. A similar structural reorientation could be achieved by the application of an external mechanical force in tension or compression.

In our previous studies [3, 4], the high-resolution reciprocal space mapping with X-ray diffraction proved itself as a good tool to study the structure in Ni_2MnGa samples which could contain several twinned domains due to the shape memory effects. The reciprocal space mapping helps to distinguish between the Bragg reflections corresponding to individual twins. Moreover, reciprocal space mapping allows the precise study of the lattice parameters and a possible modulation in the structure.

Our goal was to study the structure during the reorientation by X-ray diffraction in-situ in the applied tension. For this purpose, we mounted the tensile stage (possible load up to 4 kN) inside the diffractometer. The studied specimen was $Ni_{50}Mn_{28}Ga_{22}$ with martensitic structure at the room temperature. Besides the lattice parameters and volume ratios of individual twin variants in the various tension, the measurement revealed that the results differ in dependence on the way how the sample is hold inside the stage. Holding directly with clamps allows almost full structural reorientation at approximately 10 MPa, but the sample cracks when the twin boundary reached the place on the sample hold by the clamps. Holding by a glue prevented the reorientation and the full reorientation did not occur up to 20 MPa.

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