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Deformation induced martensitic transformation in NiMnGa ferromagnetic shape memory alloys studied by in-situ neutron diffraction

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ABSTRACT For Ni-Mn-Ga ferromagnetic shape memory alloys, the martensitic transformation produces lattice strain. Appling external deformation during the transformation imposes specific constraints to the lattice deformation thus may change the strain path of the phase transformation. To elucidate such changes, we performed in-situ neutron diffraction inspection on the Ni50Mn30Ga20 samples with 7M martensite during their thermo-mechanical treatments. The sample was first fully austenitized and then cooled to allow the occurrence of the martensitic transformation. Then the same thermal cycle was repeated and a compressive load was applied during the isothermal holding and the cooling process. Two stresses of 20 and 50 MPa were used, respectively. The stress-free and the stress-assisted transformations were studied by in-situ neutron diffraction. It is found that under a compressive load of 20 MPa, austenite transforms to 5M martensite instead of the normal 7M martensite generated following the Pitsch OR. When the compressive load was increased (50 MPa), austenite also transforms to 7M martensite but under a new OR in addition to the 5M martensite. The 5M martensite then further transformed to 7M martensite during the subsequent cooling. The formation of the new martensite products following the different transformation paths under the applied compressive load allows a maximum accommodation of the imposed macroscopic deformation by the transformation lattice deformation.

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