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Superelastic behavior of Fe-Mn-Al-Ni single crystals studied by combination of in situ characterization methods

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The superelasticity of iron-based shape memory alloys is manly determined by microstructural features like grain boundaries, precipitation size or crystal orientation and morphology. Furthermore, operating microstructural mechanisms such as the interaction of different martensite variants or dislocation interaction with the austenite/martensite phase boundary also result in a functional degradation. The acoustic emission technique was used to investigate the functional fatigue of superelastic behavior during cyclic deformation of Fe-Mn-Al-Ni single crystals under tensile and compressive loading. The interpretation of the acoustic emission data regarding the different microstructural deformation mechanisms was corroborated by complementary in situ techniques like digital image correlation (DIC), high resolution electron backscatter diffraction (HR-EBSD), electron contrast channeling imaging (ECCI) and infrared thermography (IR-TG). The recorded acoustic emission signals showed a decrease in intensity with increasing cyclic deformation and different mechanisms appearing during forward and reverse martensitic transformation.

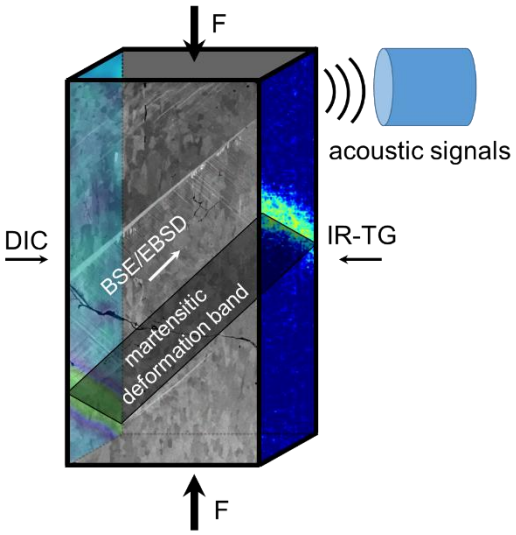

Fig.1 (in situ compression test)

Keywords: shape memory alloy, acoustic emission, EBSD, ECCI, martensite stabilization