Simulation of CuAlBe tensile test using SMA constitutive law and comparison with in-situ synchrotron data

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Technological evolutions in terms of X-ray image acquisition allow via large instruments to have more and more accurate data in the mechanics of materials field [1,2]. A polycrystalline CuAlBe sample was observed under in-situ tensite using Diffraction Contrast Tomography and 3D-X Ray Diffraction techniques. The coupling of these techniques brings the initial geometrical data of the microstructure as well as their evolution during the loading and, by post-processing, the mechanical state [3]. In this study, a geometrical reconstruction of the sample is carried out using NEPER software, then imported into the Abaqus Finite Element Analysis software. The tensile test is simulated, the intragranular behavior of CuAlBe being modeled by a single crystal behavior law describing the martensitic transformation [4]. Thus, comparisons are made between numerical and experimental results at the grain scale. Numerical simulations bring additional information on the intragranular mechanical state allowing an improved understanding of the mechanisms inducing the formation of martensite and its evolution. Moreover, the influence of the crystallographic orientation of the grains on their neighborhood is revealed.

Keywords: Finite element modeling, shape memory alloy, martensitic transformation, internal stress, 3D-high-energy synchrotron X-ray diffraction

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