

IN-SITU OBSERVATION OF THE MARTENSITIC TRANSFORMATION OF INDIVIDUAL GRAINS USING A HIGH-ENERGY X-RAY MICROBEAM

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Martensitic transformations are nowadays acquiring an increasing technological relevance in a broad scope of high-performance materials, ranging from fully austenitic steels and high-strength multiphase steels to shape-memory alloys and ceramic composites. However, there is a lack of in-situ experimental information on the martensitic transformation behavior of individual grains, which is essential to optimize the overall mechanical properties of the material. In this sense, in-situ three-dimensional synchrotron X-ray diffraction has become a powerful tool to monitor individual grains within the bulk of polycrystalline materials. In this study, we have focused on low-alloyed multiphase TRIP steels, who are attracting a great interest due to their high strength and good formability. The Transformation Induced Plasticity (TRIP) effect, who is considered to yield a significant contribution to the large total elongation of these steels, stems from the transformation of the metastable (face-centred cubic) austenite phase into the (body-centred tetragonal) martensite phase. We have succeeded in monitoring in-situ the martensitic transformation of a significant number of individual grains during cooling the material, using an intense microbeam of high-energy X-rays (80 keV). For each of the grains, the martensitic transformation temperature has been correlated to local microstructural parameters like the interstitial carbon concentration and the grain size. We have found a clear dependence of the grain stability of the metastable phase on the grain size, revealing the existence of a critical size below which the martensitic transformation is completely suppressed.

[1] N.H. van Dijk, A.M. Butt, L. Zhao, J. Sietsma, S.E. Offerman, J.P. Wright, S. van der Zwaag, *Acta Mater.* 53 (2005) 5439

[2] E. Jimenez-Melero, N.H. van Dijk, L. Zhao, J. Sietsma, S.E. Offerman, J.P. Wright, S. van der Zwaag, *Scripta Mat.* 56 (2007) 421