Metastable Austenitic Steel Deformation at Low Temperature

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Austenitic stainless steel type 304 is well known as a metastable steel that may be transformed to have different crystal structures during plastic deformation [1] leading increase in strength and elongation, i.e. transformation-induced plasticity (TRIP) [2]. A commercial JIS-SUS304 steel was used for in situ neutron diffraction measurement during loading at RT up to the fracture with a strain rate of 2.3×10^{-5} s^{-1}, but TRIP was not observed [3]. This may be because that the strain rate was too slow and/or the temperature was too high to lead TRIP occur. TRIP in the JIS-SUS304 can be accelerated by decreasing the temperature for the deformation and increasing the strain rate [1], and the flow stresses are different by varying the temperatures, expecting that the transformation behavior may be different. To describe the relation between the flow stress and the transformation behavior, in situ loading measurements of the JIS-SUS304 at low temperatures were performed.

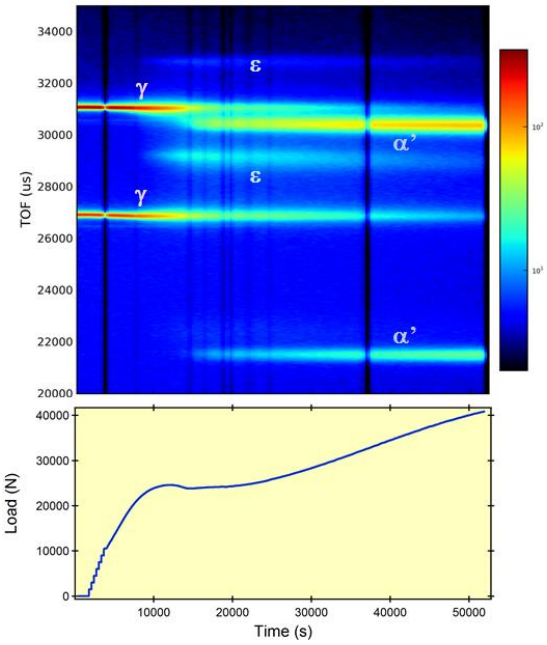

Fig. 1 Changes of diffraction pattern and load with respect to time during deformation of stainless steel type 304 at 113 K.

Figure 1 shows changes of diffraction pattern and load with respect to the time, from the in situ loading experiment of the JIS-SUS304 at 113 K that was performed at BL19 Takumi of MLF, J-PARC with a strain rate of 1×10^{-5} s^{-1}. When plastic deformation starts, transformation to ε (hcp) phase occurs followed by decreasing the flow stress, and during subsequently plastic deformation α‘ (bct) phase is formed followed by recovering the flow stress.

References

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