DEFORMATION BEHAVIOUR OF 304 STAINLESS STEEL EXPERIMENTAL AND MODELLING

B. Petit* **, N. Gey*, F. Abed-Meraim**, M. Humbert*, T. Ben Zineb**, B. Bolle*, M. Cherkaoui**

* LETAM CNRS - Université de Metz, Ile du Saulcy, F-57045 Metz Cedex

** LPMM ENSAM - CNRS - Université de Metz, Ile du Saulcy, F-57045 Metz Cedex

The austenitic stainless steels are characterised by remarkable mechanical properties, combining high ductility and high strength. Their plastic deformation involves a wide variety of strain induced deformation mechanisms, strongly related to the alloy stacking fault energy. With increasing SFE, martensitic transformation sequences ($\gamma\rightarrow\alpha'$, $\gamma\rightarrow\varepsilon\rightarrow\alpha'$), deformation twinning, glide of dissociated or perfect dislocations can occur.

A quantitative modelling of such a deformation behaviour, with real predictive capabilities, has been developed recently. It is formulated in terms of finite strains and takes the various inelastic strains encountered in the material into account. In particular, two inelastic deformations are considered, either ε martensite transformation strain or twinning strain, depending on the testing temperature, and the α' transformation strain. Thermomechanical couplings are realised between these two inelastic deformation modes. The model which uses a self-consistent method for the scale transition, allows us to calculate the global behaviour of the polycristal.

In this contribution, this new model is applied to foresee the behaviour of a 304 stainless steel, tensile tested in a temperature range of -60°C to room temperature. Besides, large experimental investigations were performed on various 304 specimens. In particular, X-ray diffraction was used to quantify the volume fraction of the α' and ε martensite and to determine the texture evolution of the parent and the product phases. The local microtextures were analysed with the EBSD technique in a SEM FEG. The predictions obtained with the micromechanical model are compared to the different experimental results, notably the mechanical behaviour and associated deformation mechanisms, the transformation kinetic as well as the texture evolution.