Grain size effect on the mechanical behavior of metastable Fe-23Cr-8.5Ni alloy

An Fe-23Cr-8.5Ni alloy was used as a model material to study the grain size effect on the mechanical behavior of metastable duplex metal. Alloy samples with different grain sizes ranging from 0.1 to 2 µm were prepared by cold-rolling and annealing. A structural refinement to about 0.1 µm results in a high yield strength but very limited ductility. A significant improvement of ductility occurred at the grain size of about 0.4 µm. A further increase in grain size results in a decreased strength and a slightly improved ductility. The alloy with a grain size of about 0.4 µm exhibits an excellent combination of strength and ductility, where the yield strength and tensile elongation are increased up to 738 MPa and 29% as compared to 320 MPa and 33% of a coarse-grained (about 2 µm) sample, respectively. The origin of the excellent mechanical properties was attributed to the unique deformation characteristics associated with the transformation induced plasticity and the development of back stress.