# Mechanical characterization by small punch tests of ultra-fine grained AISI 316L with bimodal grain size distributions

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**Abstract.**

In this article, the mechanical behavior of austenitic stainless steel 316L samples is characterized by small punch tests [1] at room temperature (RT), 300°C and 500°C. These samples were obtained by powder metallurgy associated with spark plasma sintering. Two kinds of samples were sintered. Samples with unimodal grain size distributions were sintered with an average grain size of 0.3, 1 µm (UltraFine Grains - UFG) and 10 µm (Coarse Grains - CG). Specimens with bimodal grain size distributions were also sintered with an UFG matrix (0.3 µm) and coarse grains of 10 µm. In order to characterize the influence of the volume fraction of each grain size population on the mechanical behavior, samples with 75%, 50%, 25% of UFG volume fraction were sintered.

Samples were submitted to small punch tests in order to characterize the ductility of the samples. At RT, brittle fracture is observed for unimodal UFG samples compared to CG ones which exhibit ductile fracture. For bimodal samples, brittle fracture is characterized if this volume fraction is lower than 50%. Nevertheless, compared to unimodal UFG samples, despite similar fracture mechanisms, the introduction of a volume fraction of 25% of coarse grains increases the straining capacity of the samples of the bimodal samples.

With an increase in temperature, the fracture mechanisms are not modified but a ductility increase is observed which, in turn, reduced the difference in this parameter between unimodal and bimodal samples. This result is in agreement with the homogenization of the mechanical behavior between ultra-fine and coarse grains reported in tension [2].

References:

[1] E. Altstadt, M. Serrano, M. Houska, and A. Garcia-Junceda. Materials Science and Engineering, A 654 (2016) 309-316.

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