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## Residual ferrite in martensitic stainless steels: the effect of mechanical strength contrast on ductility

Alvise Miotti Bettanini<sup>a,\*</sup>, Florent Hannard<sup>a</sup>, Jean-Denis Mithieux<sup>b</sup>,  
Guillaume Badinier<sup>b</sup>, Pascal J. Jacques<sup>a</sup>, Thomas Pardoën<sup>a</sup>, Laurent  
Delannay<sup>a</sup>

<sup>a</sup>*Institute of Mechanics, Materials and Civil Engineering, Université catholique de Louvain,  
B-1348 Louvain-la-Neuve, Belgium*

<sup>b</sup>*Aperam Research Center, BP 15, 62230 Isbergues, France*

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### Abstract

Ductile damage process of a martensitic stainless steel with 15 vol.% of residual ferrite and two populations of carbide particles is investigated using a combined multiscale experimental and modelling approach. Whereas Nb-rich carbides contribute to grain refinement, coarser Cr-rich carbides are preferential damage nucleation sites. Three different heat treatments are applied to partially dissolve Cr-carbide particles while keeping the same ratio of ferrite versus martensite volume fraction. Surprisingly, ductility decreases with decreasing volume fraction of Cr-carbides. Nanoindentation mapping indicates that the strength contrast between ferrite and martensite increases with carbide dissolution. According to finite element simulations of strain partitioning inside the two phase microstructure, the stress triaxiality in ferrite increases with the mechanical strength contrast. This promotes void nucleation and growth, reducing the fracture strain.

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\*Corresponding author

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