Effect of microstructure on low temperature ductility of hot stamping martensitic stainless steels for automotive applications

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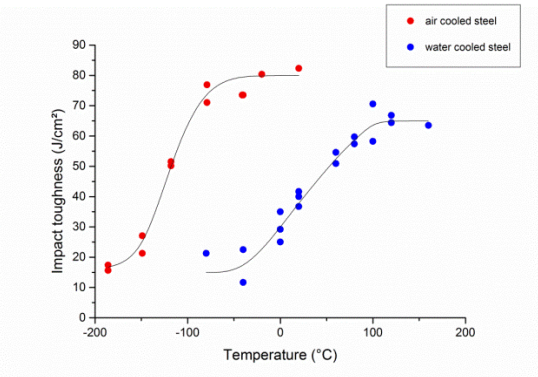

- Heat treatments
- Microstructural analysis (SEM, TEM)
- Charpy tests
- Tensile tests (from 20°C to -196°C)
- Local approach of fracture (numerical simulation)

Abstract:

Growing demand for passenger protection and emission reduction leads to the continuous development of high strength steels used in automotive industry. Hot forming of martensitic steels is a very attractive process to reach very high mechanical resistance in formed parts, avoiding difficulties arising from cold forming of multiphase high strength steels. Coming after a decade of industrial experience with 22MnB5, martensitic stainless steels optimised for hot stamping constitute a major step forward, combining process simplification (suppression of AlSi coating, ultrafast heating, air-hardening, multi-step forming) and improved material performance (bending, fatigue, corrosion). Among key properties required for automotive structural parts, impact toughness is one component controlling crash worthiness. This project focusses on the brittle fracture resistance of laboratory steels from this family, for various chemistries and processing conditions. To identify quantitative fracture criteria, the values of critical cleavage fracture stress have been determined for each condition by combining low temperature tensile tests on notched specimens and mechanical analysis by the finite element method. On the other hand, the effects on the characteristic microstructural lengths, carbon distribution and retained austenite stabilization have been investigated to explain the variations in brittle fracture resistance.