STUDY OF THE EMBRITTLEMENT OF A STAINLESS MARTENSITIC STEEL UNDER EXTREME COOLING CONDITIONS

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Optical Microscope cross sectional view of a fractured Resistance Spot Weld

- Monitoring of preferential crack propagation during cross tension tests, and its relation to the toughness of weld regions
- Study of local stress fields inherent to spot weld geometry using a Finite Element Model
- Approximation of the phase transformation sequence using a electro-thermo-metallurgical model (SORPAS) to reproduce synthetic microstructures and characterize their resistance to fracture

Abstract:

Among the various criteria used to evaluate a new steel grade intended for the automotive industry, spot weld strength is crucial as Resistance Spot Welding (RSW) is the most frequently used joining technique for car structures. Although they present many advantages, Martensitic Stainless Steels tend to form brittle spot welds, since RSW involves very fast cooling sequences. The work aims at finely understanding embrittlement induced by RSW, by analyzing the effect of the welding cycle parameters on the final microstructure and mechanical properties of the weld, for a given steel chemistry. This involves determination of cross tensile strength for spot welds issued from different cycles, of fracture paths and microstructural characteristics. The results are to be capitalized into a model correlating weld performance with spot weld characteristics, the interconnected characteristics being:

- The mechanical state of the specimen during cross tension test, which involves the thermo-mechanical simulation of the different weld region, and the creation of a FE model,
- The final microstructure of the specimen and its transformation history, which are to be determined by using local chemical analysis, EBSD and numerical simulation of local thermal history.