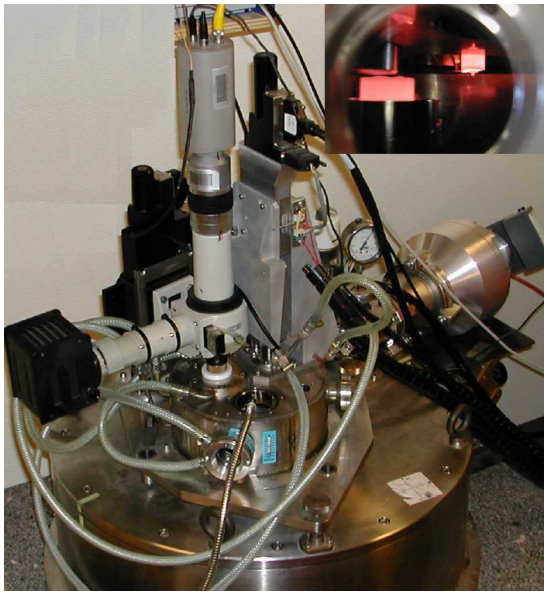
Application note : Yield stress determination

Michalex

ONERA

HTIIS 1000: High Temperature Instrumented Indentation System **1000°C**

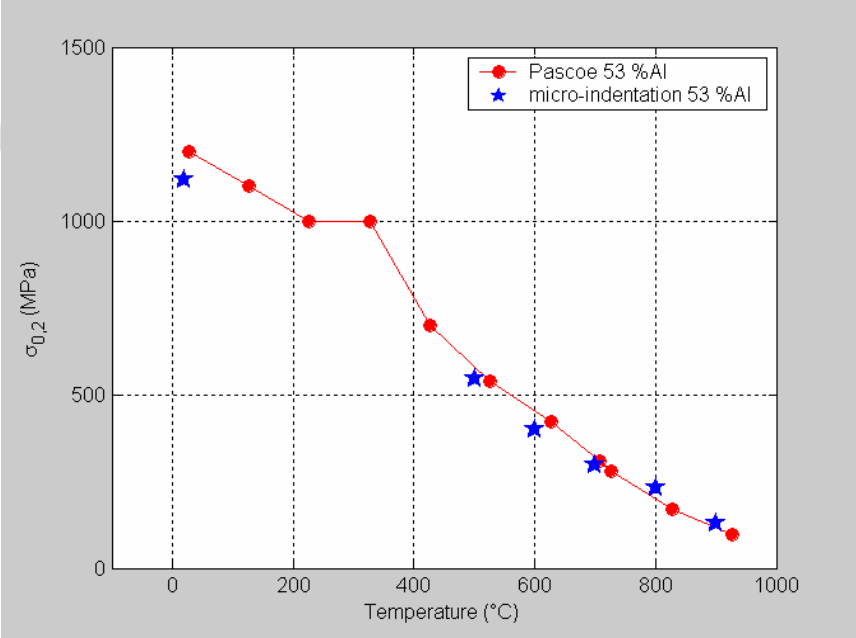
Yield stress is one of the most important materials' properties designers consider during material selection and is critical for service life performance of materials used in extreme environments. The determination of materials' yield stress in their operating environments is sometimes difficult to measure using classic tests. For coatings, operating at elevated temperatures, instrumented micro-indentation has now been developed to enable the determination of yield stress up to 1000oC of the coating itself without any modification of its structure due to sample preparation.



Under the micro-indentation stress field, high shear stresses and plastic deformation creating an opportunity to probe elasto-viscoplastic response of materials at the local scale. Using time dependent constitutive models, experimental results are analyzed to provide complete description of the equations describing the material's response. In particular, yield stress can be extracted and results, as shown below, are comparable to results obtained from classic tensile tests.

Comparison of the yield stress (strain rate of 10-4 s-1) of NiAl derived from stress-strain curve calculated from the constitutive law identified from micro-indentation data to literature data

Courtesy A. Villemiane



The mechanical properties of NiAl compounds are highly dependent on the composition of the alloy, in particular the aluminium content, the temperature and the strain rate. The experimental data obtained by Pascoe and Newey with conventional characterisation methods on a Ni47Al53 alloy for a strain rate of 10-4s-1 are compared in the figure with our estimated yield stress for a bulk specimen having the same composition. As we can see, a good agreement on a large temperature range has been obtained.

Michalex 86 rue de Paris Bat Erable 91400 Orsay France

Tel : + 33 1 77 93 21 00 Fax : + 33 1 64 46 12 03 www.michalex.com