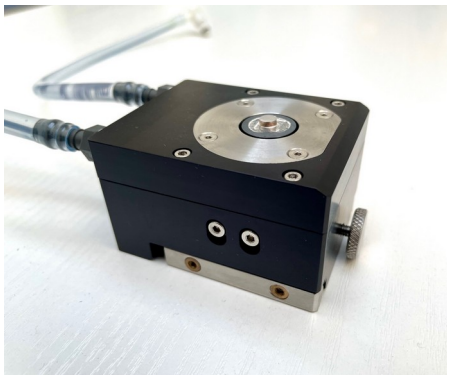
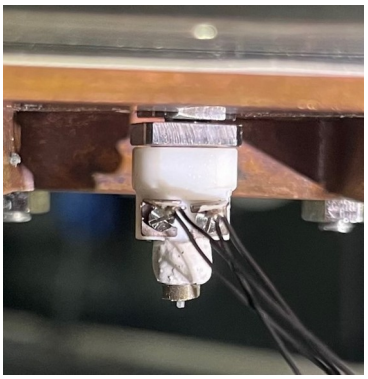
Application note

High temperature nanoindentation

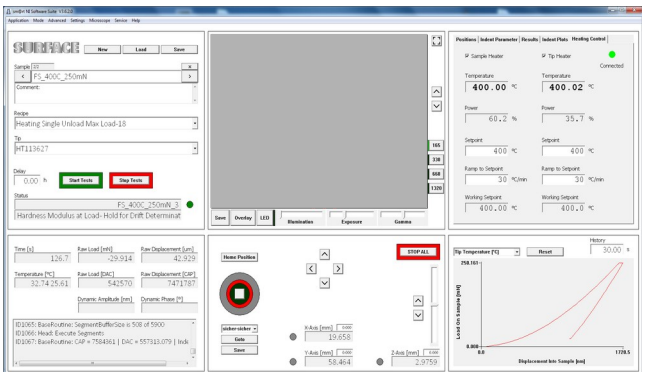
Heating stage and active heating tip for sm@rt 500 nanoindenter:



Heating stage with height adjustment and cooling water hoses

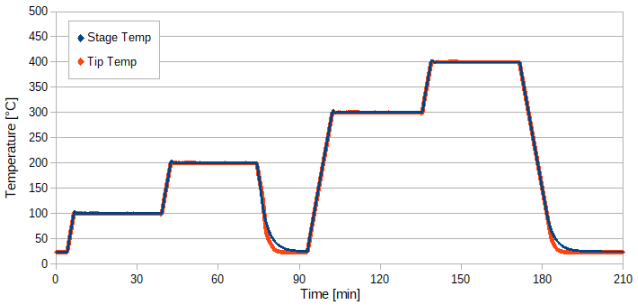


Indenter tip with active heating-element and Pt-temperature sensor

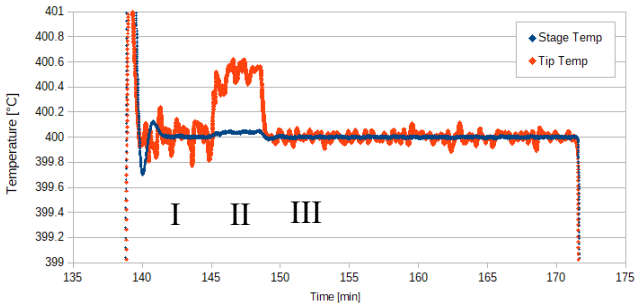


Heating stage control integrated in software

- sample heating up to 500°C
- max. sample size: Ø16 mm, height 3 mm
- thermocouple type K
- stability ± 0.02°C
- active indenter tip heating up to 500°C
- platinum resistance temperature sensor
- cooling water circuit and inert gas supply
- sm@rt plus controller
- fully integrated in software



Temperature profile for high temperature tests; Stage and tip heater are controlled by individual feedback loops.



I: settling of stage and tip temperature
II: motorized approach of tip and sample
III: multiple tests under stable conditions

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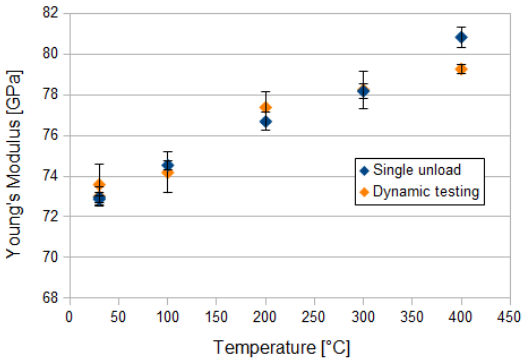
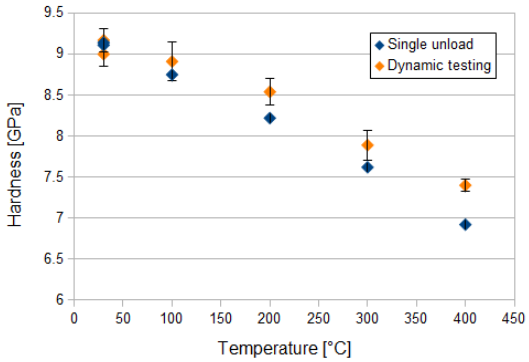
Application note

Test results on fused silica reference material:

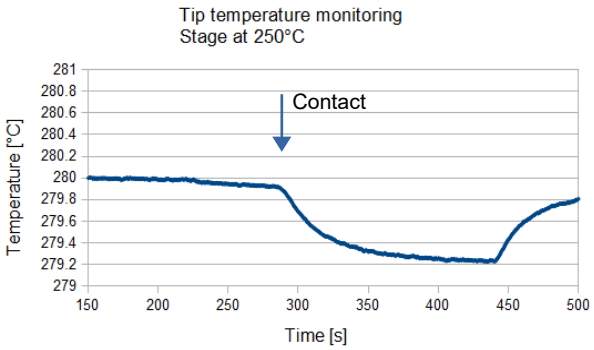


The Young's modulus of fused silica shows a linear increase with temperature. It is used to validate the test system at elevated temperatures.

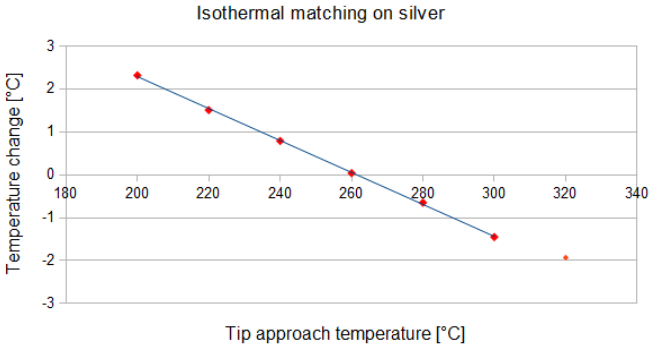


The hardness is measured to be smaller at the single unload tests due to the influence of creep during peek hold segment.

Isothermal contact with tip heating:

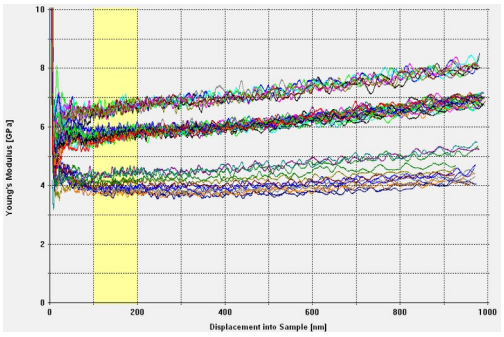


When there is a significant temperature mismatch between tip and sample, the temperature of the tip heater changes during the indentation test (feedback off).

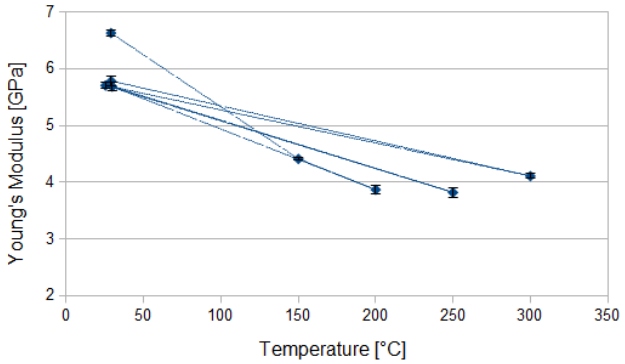


The change of the tip temperature, when indenting into the sample, can be used to determine the tip temperature setting for isothermal contact.

Dynamic testing on polymer sample:



Modulus over displacement for different sample temperatures.



Young's modulus results, the error bars represent the standard deviations from the mean values.

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