CONSTANT CONTACT STIFFNESS INDENTATION RELAXATION TEST

Paul Baral, UdL, ECL, LTDS UMR CNRS 5513, 36 avenue Guy de Collongue, 69134 Ecully, France
paul.baral@doctorant.ec-lyon.fr
Gaylord Guillonneau, UdL, ECL, LTDS UMR CNRS 5513, 36 avenue Guy de Collongue, 69134 Ecully, France
Guillaume Kermouche, EMSE, Centre SMS, , France
Jean-Michel Bergheau, UdL, ENISE, LTDS UMR CNRS 5513, France
Jean-Luc Loubet, UdL, ECL, LTDS UMR CNRS 5513, 36 avenue Guy de Collongue, 69134 Ecully, France

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Nanoindentation test is of great interest to characterize small scale mechanical behavior, thus a large literature exists on the field. Nevertheless, measurements of time dependent mechanical properties by this technique is still to be improved [1]. It is proposed to investigate the indentation relaxation from a different point of view. Indentation relaxation tests are usually performed keeping a constant displacement over a prescribed time duration [2]. This experimental procedure is consequently very sensitive to the system drift. Hence, determination of relaxation behavior is limited to few hundreds of seconds in the best cases. Weihs and Pethica [3] and Maier *et al.* [4], proposed to use the continuous contact stiffness measurement as a robust measure of the contact area. Based on these studies, a novel experimental procedure has been developed. Contact stiffness is kept constant after loading to a prescribed depth, for a define period, while displacement and load are monitored. As the contact stiffness measurement is not sensitive to drift, this method allowed to perform relaxation experiments with very long hold segment. Experiments on fused silica and polymers - i.e. PMMA, PC and PS - at room temperature have been performed with a constant contact stiffness maintained up to 10 hours. It has been shown that the dispersion on the force, F, was greatly reduced (see Figure 1). This could be understood as constant contact stiffness experiments were much less affected by the system drift than constant displacement ones. This new method opens the way to time dependent mechanical characterization in a wider range of conditions, especially long time experiments and high temperature indentation tests.

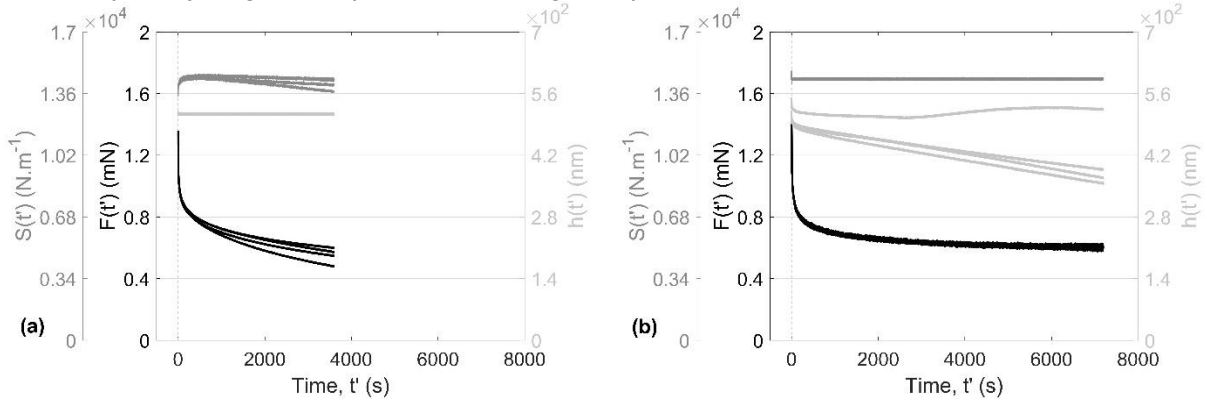

Figure 1 – Two sets of four relaxation tests performed on PMMA. t' is considered as the time from the beginning of the hold segment. (a) Displacement is maintained constant during one hour and significant discrepancies appear in load and contact stiffness measurements. (b) Contact stiffness is maintained constant during two hours. Drift can be directly estimated through displacement measurements and no discrepancies can be seen on load signal.

References

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