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A NEW HIGH DYNAMIC MODULE FOR IN-SITU NANOMECHANICAL TESTING AT HIGH STRAIN RATE

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In-situ nanomechanical testing is commonly used to probe surface mechanical properties of bulk materials or thin films, like hardness, Young's modulus, Yield stress... Actually most of the instruments can measure these properties only statically, i.e. a low frequency, leading to property measurement only at low strain rate (usually 10^{-1}s^{-1} by nanoindentation). This is mainly caused by the low resonance frequency of the system, preventing making tests at higher speed. Performing high dynamic measurements could bring new information on materials properties like deformation mechanism at high strain rate, or high dynamic fatigue properties.

A new high dynamic module usable for in-situ mechanical testing has been developed. It is composed of a small piezotube attached directly behind the tip. Because of the small dimensions of the module, his resonance frequency is very high (higher than 50kHz) in comparison to classical nanomechanical testers, permitting to perform and measure precisely the signals at very high frequency. Moreover, it can be used as a sensor and as an actuator, in x, y and z directions which gives to this module a very large range of measurements.

Firstly, the characteristics, the performances and the limits of the new high dynamic module will be presented. Secondly some indentations experiments performed at high strain rate on nanocrystalline nickel with the in-situ nanomechanical tester (Alemnis GmbH) equipped with the high dynamic will be presented and discussed (Fig. 1). Finally, some micropillar compression at high strain rate on the same material will be described and discussed.

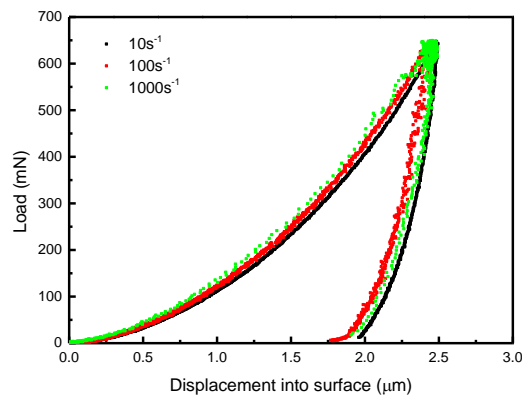


Figure 1 – Load displacement curve obtained on nanocrystalline nickel at high strain rate with the new high dynamic module.