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DEVELOPMENT AND APPLICATION OF AN IN SITU NANOINDENTER COUPLED WITH ELECTRICAL MEASUREMENTS

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The increasing demand for multifunctionality has become a recurring challenge for a wide panel of application fields such as microelectronics, microsystems, energy harvesting or structural applications.
This generally implies a smart combination of materials with tailored geometries, thus leading to ever more complex structures. The complexity of these new materials requires the development of higher performance characterization tools.
In that purpose, a multifunctional characterization set-up is developed in SIMaP laboratory, mainly based on electrical and mechanical coupling. This set-up is tailored for advanced measurements at the micrometer scale of structural and functional materials displaying small scale microstructure such as multiphase, architecture alloys, thin film/substrate stacks, small-scale system.

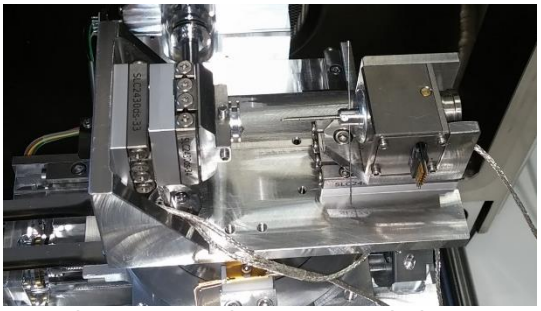

Figure 1 – In situ SEM nanoindenter

The heart of this characterization device is a nanoindenter (i.e. an instrumented force-displacement column) (Figure 1). This device can be coupled with highly sensitive electrical test instruments, which enhances quantitative analysis of mechanical behavior, such as monitoring of the contact area or deformation response of oxide layers (Figure 2).
This nanoindenter can also be integrated in-situ in a state-of-the-art Scanning Electron Microscope, with high analytical resolution allowing the precise analysis of the indented area by using both local chemical composition and local crystallographic orientation mapping, thanks to EDS and EBSD techniques. In particular microstructure and mechanical behavior of complex architectured materials such as co-deformed multiscale duplex stainless steel can be investigated (Figure 3).
This work is performed within the framework of the Centre of Excellence of Multifunctional Architectured Materials "CEMAM" [1] n° AN-10LABX-44-01 funded by the "Investments for the Future" Programme.

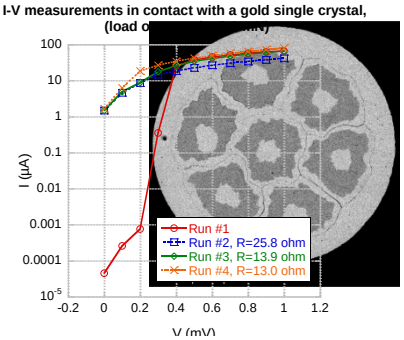

Figure 2– Oxide layer fracture a gold single crystal by

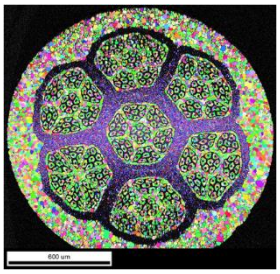

Figure 3– Co deformed multiscale duplex stainless steel (from Ugitech).

[1] http://cemam.grenoble-inp.fr/