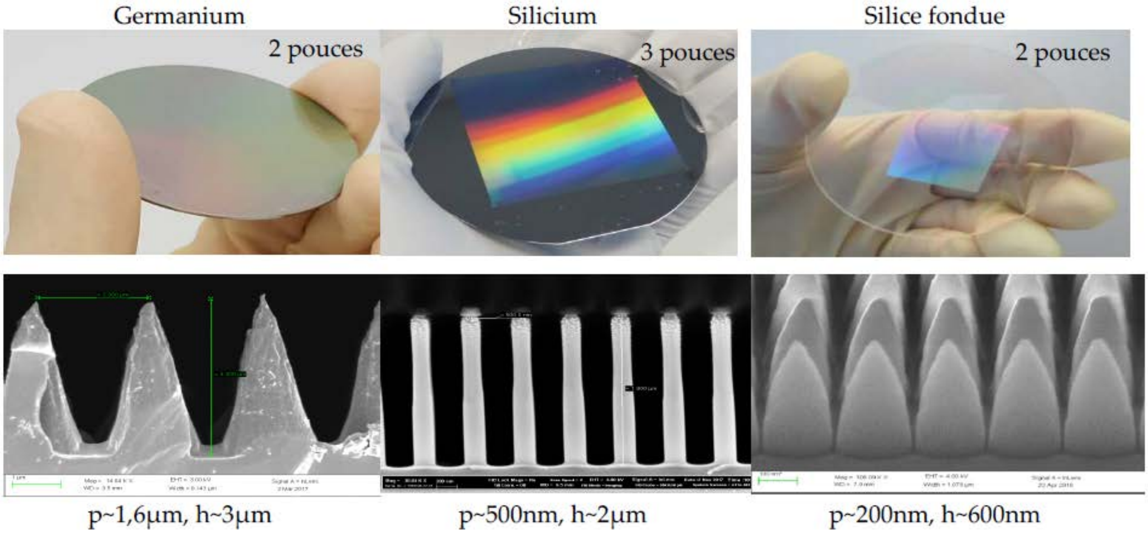
10 months Post-doc position available (starting between October 2019 and January 2020)

at the Laboratoire de Mécanique des Solides, CNRS, Ecole Polytechnique, Palaiseau, France

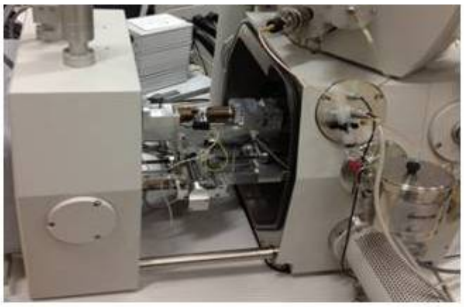
under the supervision of Dr Véronique Doquet

Experimental characterization and numerical analysis of the mechanical properties of nano-structured substrates for optical applications.

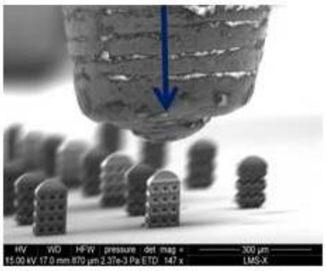


The proposed position is related to project F-Mars (January 2019-2022, funded by DGA) involving Thales TRT, the laboratory "Physique et Mécanique des milieux hétérogènes" at ESPCI and the LMS, aiming at the development of multifunctional optical windows that should be antireflective and superhydrophobic, but should also withstand various mechanical loadings [1-2]. Thales will manufacture nanostructured glass or single crystal Silicon or Germanium substrates, coated with hard DLC or alumina thin films. The aim of the project is to optimize the nanostructure design, as well as the elaboration process of the hard coatings, relative to the functional properties and the mechanical durability. LMS is in charge of the latter aspect.

The post-doc will participate to the definition of suitable micromechanical tests to determine the hardness, elastic properties, and residual stresses of hard coatings, and the resistance to fracture and wear of nanostructured and coated glass or single crystal Silicon or Germanium substrates, as well as the resistance to bending and buckling of single conical nanostructures due to normal or lateral impacts (e.g. by water droplets or hailstones). He/she will run these tests (with some technical support from the labs technical staff). He/she will also run finite element simulations (on elastically anisotropic materials) for the mechanical optimization of nanostructures design and for a proper analysis of test results. Some of the tests (buckling or bending of single nanostructures) will be performed under an AFM, some in a scanning electron microscope (wear tests), some on a dual-beam SEM (FIB micro-milling associated with high-resolution digital image correlation to measure residual stress relaxation-induced strain fields and deduce the residual stresses [3,4]), some on a nano-indentor, and some (biaxial bending until fracture) on classical testing machines [5]. He/she will periodically have to make presentations of the work to the other participants in the project.



Tension, compression or bending inside the SEM with HR-DIC strain field measurements



Compression of lattice structures inside the SEM

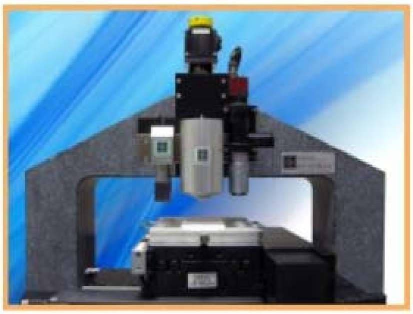


Photo du nanoindenteur TI950

AFM **Nanoindentor**

References.

[1] D.S. Hobbs, Study of the Environmental and Optical Durability of AR Microstructures in Sapphire, ALON, and Diamond, Proc. of SPIE Vol. 7302 73020J-1-12, doi:10.1117/12.818335

[2] Kyoo-Chul Park et al., Nanotextured Silica Surfaces with Robust Superhydrophobicity and Omnidirectional broadband Supertransmissivity, ACS Nano. 6(5):3789-99, 2012

[3] A. M. Korsunsky, M. Sebastiani, E. Bemporad, Residual stress evaluation at the micrometer scale: Analysis of thin coatings by FIB milling and digital image correlation, Surface & Coatings Technology 205 (2010) 2393–2403

[4] M. Krottenthaler, C. Schmid, J. Schaufler, K. Durst, M. Göken, A simple method for residual stress measurements in thin films by means of focused ion beam milling and digital image correlation, Surface & Coatings Technology 215 (2013) 247–252

[5] M Dube, V. Doquet, A Constantinescu et al. Modeling of Thermal Shock-Induced Damage in a Borosilicate Glass, Mechanics of Materials 42, 863–872, 2010.

The candidate should necessarily hold a PhD in the field of experimental mechanics of materials. Applications, including a resume highlighting the candidate's training and experience in experimental mechanics and finite element simulations, a publications list, and recommendation letter(s) should be sent to: doquet@lms.polytechnique.fr