M2 internship and funded PhD thesis (2018)

Soft polymer adhesion on patterned substrates

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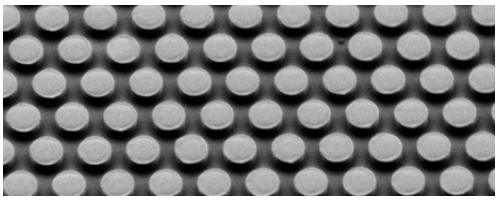
Control of adhesion strength and detachment dynamics of soft adhesive materials is a key improvement lever for many industrial applications. The proposed thesis is funded by the ANR project AdhesiPS that investigates how substrates patterned with micro-structured 3D topography (figure) and chemically-induced adhesive heterogeneities can be used to control the bonding and debonding of a soft adhesive. The exploration of a wide range of substrates will allow us to progress in the fundamental understanding of the dissipation mechanisms during the debonding of soft adhesives as well as to find strategies to tune their adhesion from much lower to much higher values than the one on a smooth surface.



PDMS surface with a hexagonal array of cylindrical pillars obtain through e-beam lithography. Pillar diameter 4µm, height 3µm.

Part of the thesis will be devoted to the production of micro-patterned substrates of large size using laser or e-beam lithography, wrinkling instability and chemical stamping. The PhD student will then investigate experimentally the impact of the patterned substrates on the adhesive detachment/peel process. To do so, he will develop a nanotribometer and a peeling experiment both allowing very fine measurements of the detachment/peel force as well as high resolution imaging of the detachment process. It is also planned to access experimentally the deformation and the stress fields inside the adhesive material during debonding via microscopic optical methods (Digital Image Correlation and fitting of the shape of the tape backing) which measurements are crucial to progress in the understanding of the dissipation mechanism explaining the level of adhesion.

Beside the development and realization of experiments, the PhD student will be fully involved in the data analysis and in their comparison to existing theoretical formalism. Applicants should have received a high-level education in physical mechanics, non-linear physics or polymer physics.

The PhD thesis will be realized at Laboratoire de Physique des Solides and laboratory FAST both hosted by Université Paris-Sud. It is funded by the ANR project AdhesiPS involving also the Laboratoire de Physique at ENS de Lyon and the Institut Lumière Matière of Université Claude Bernard Lyon 1.