"Surface patterning of metals: principles and applications"

Surface patterning is an exciting challenge for the thin film and surface engineering community. Surface patterning, also known as surface texturation or surface structuration is a part of surface engineering that consists in the production of a "patterned" surface with some regular array of surface height features on the size scale of several micrometres to some nanometres. Patterned surfaces have many potential applications in various fields such as surface energy, optics, biology, mechanics, combinatorial chemistry for sensing analysis or synthesis, microfluidics, microelectronics…. Surface patterning manufacturing methods are widely used in the semiconductor industry. However, these technologies are mostly specific to silicon, highly sophisticated and expensive. Alternative cheap and flexible technologies are thus needed to satisfy the waste demand for emerging applications. This seminar will focus on metal patterning for surface engineering based on structures ranging from few nanometres to millimetres in size. We will limit our purpose to plasma, electron and ion beam patterning techniques. The different techniques for surface transformation will be examined using the following classification:

- Adding material: the patterned surfaces are created by addition of material to the desired surface, creating small areas of relief (lithography, physical or chemical vapour deposition with masks, deposition coupled to micro or nanosphere lithography…).
- Removing material: the patterned surfaces are produced by removal of material of the surface, creating small depressions (lithography, writing with electron or ion beam…).
- Moving material: the change in the surface structure is attributable to elastic or plastic deformation and redistribution of material from some parts of the surface to others (controlled wrinkling, laser interference metallurgy).
- Self-forming: a disordered system of components, already on the surface or brought to the surface, forms an organized pattern as a consequence of specific, local interactions among the components themselves (pore forming materials such as porous alumina or gels and carbon based templates…).

In the first part of this presentation, the results reported in the literature will be reviewed. The second part of this presentation will concern the new technique we developed in our institute. This new concept of surface patterning belongs to the third category of this classification. It is applicable to austenitic materials forming the so called “expanded austenite phase”. The redistribution of material from some parts of the surface to others is based on a selective plasma assisted diffusion treatment of stainless steel substrates masked by TEM grids of different mesh side.