# Pulse Plating processes for nanostructured microsystems: NIL Biochip systems

**W.E.G. Hansal[1], S. Hansal[1], G. Sandulache[1], V. Grman[1], C. Preininger[2], M. Mühlberger[3]**
[1] Happy Plating GmbH, A-2544 Leobersdorf, Austria
[2] Austrian Research Centers GmbH ARC, Department of Bioresources, A-2444 Seibersdorf
[3] Profactor Produktionsforschungs GmbH, A-4407 Steyr-Gleink, Austria

This works focuses on the development of enhanced biochip systems. The major advantage of biochips over conventional biological techniques is the highly parallel, addressable, miniaturized array format, which allows simultaneous detection of different targets, virtual automation and functional integration for high throughput screening. To date the technologies are mainly restricted to the research lab due to their high cost, difficult handling procedures and the lack of approved standards. In order to facilitate widespread use of the biochip as an analytical tool, certain technical hurdles, such as insufficent sensitivity still have to be overcome. Thus, one of the major challenges to further developing biochip technology is to strengthen the signals produced by probe-target interaction, especially in cases of low probe and target concentrations.

In this joint Austrian research project, the focus is laid on a completely new signal enhancement strategy, namely the use of UV-nanoimprint lithography (NIL) for a) biochip micro / nanostructuration for increased immobilization capacity, b) fabrication of microlens arrays for improved light management and c) surface enhanced fluorescence (SEF) detection.

Surface enhanced fluorescence occurs between a fluorophor and a metal cluster film or metal particle in a certain distance. In order to tune the proper distance, the thickness of the intermediate layer needs to be well defined versus fluorescence boosting. To get a constant, reproducible factor of signal enhancement the metal cluster film must adhere well to the chip and must not chemically degrade over time.

The required metal cluster films are fabricated by a combination of chemical and electrochemical methods. By a first ultra-thin adhesion layer, consisting of chemically reduced ad-ions, the surface of the substrate is tailored for the electrochemical cluster formation.

Happy Plating introduces a new approach for controlling the two critical processes that are fundamental for the cluster formation, the arrival and adsorption of metal ions at the surface and the motion of the adsorbed ions on the surface will be introduced. Ultra-short current/potential pulses in a special frequency and shape set-up will provide the surface structure required for the homogenous and stable cluster growth. The choice of metal system is crucial for the performance of the clusters. The development of the pulse plating process as well as defining and electrochemical testing of the electrolyte systems required, are subjects of this running project.

The challenge in NILbiochip will be to handle the materials which have so far not been used for NIL and develop processes which are compatible with the biochip functionality. NIL will be evaluated with respect to other deposition techniques (μCP, arraying) and the assay performance of a model protein chip (biomarker protein chip for detection of sepsis).