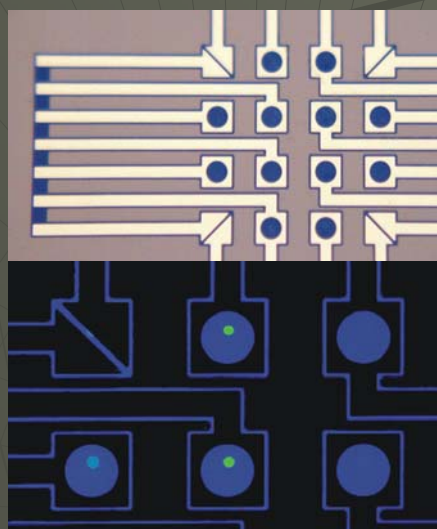
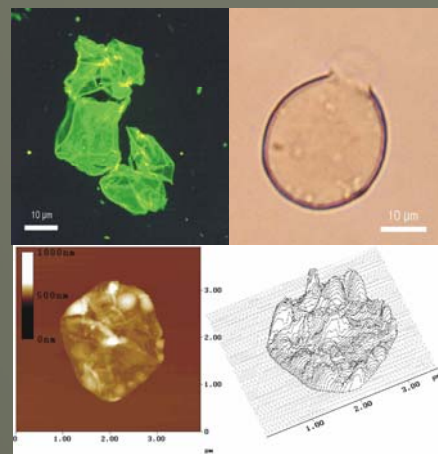


Nanoengineered Core-Shell Materials and Microfabrication Technologies for Bioanalytics, Medicine and Biochips

Nanoengineered Encapsulation

Encapsulated substances find an increasing number of applications in biotechnology, medicine and cosmetics. Encapsulation of protein crystals was achieved by sequential adsorption of oppositely charged polyelectrolytes. This extension of the so called Layer-by-Layer technique to crystalline materials leads to their encapsulation in a nanoscale polymer multilayer capsule of 15 nm thickness. The enzymes catalase and glucose-oxidase were successfully encapsulated in their solid state. The enzyme loaded μ -sized capsules represents a new class of μ -bioreactor with an extreme high loading density of bio-compound. Our approaches for the encapsulation of bio- and organic-crystalline materials demonstrate an alternative strategy to conventional encapsulation methods with the potential to create novel core-shell materials with tailored functionalities by incorporating optical, magnetic, or biorecognition properties into the encapsulate.



Integration of Biological Materials into Microfabrication

Microtechnology and Life Sciences are key areas for research, innovation and commercial development. A technology that provides an interface between the life science "bio world" and today's semiconductor and polymer based "electromechanical world" would open new avenues for research and potential product.

We developed a new technology that demonstrates for the first time the integration of biological materials (DNA) into microfabrication. The technique based on a passivation layer to protect biomolecules during the microfabrication process. The passivation layer can be applied and removed from the biomolecules under mild conditions. The method is photolithographic based and scalable for industrial mass production. Microelectronic/mechanic devices with integrated DNA or antibodies have a wide range of potential applications in bioanalytics, medicine and environmental monitoring.

Microcapsule-PCR

The polymerase chain reaction (PCR) is an important method in molecular biology with various applications in clinical research, diagnostics and biotechnology. Today, PCR reactions are carried out in reaction tubes or micro titer plates. Only 48 to 1539 reactions can be carried out in parallel. This number is too small to perform large screening projects, e.g. in pharmacological research in appropriate time. To perform a higher number of reactions in parallel, the integration density must be increased and the reaction volume decreased. This has limited chance to succeed by using the current technology.

We developed a totally new approach to overcome those limitations. The technology of "Microcapsule-PCR" allows to perform millions of PCRs in parallel in a single reaction tube. "Microcapsule-PCR" is based on the encapsulation of PCR mixtures into microcapsules of $\sim 50 \mu\text{m}$ in diameter by using our technique of matrix assisted encapsulation. Capsules create a compartment to separate individual PCRs from each other. They are not permeable for the PCR product but permeable for reactants (dNTPs). This allows to feed reactants from the outside while PCR product accumulate in the interior of capsules. Finally, individual capsules can be isolated and analyzed.

