Labelfree biosensing with impedimetric and thermal detection methods

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The first part of this presentation addresses the detection of single-nucleotide polymorphisms in DNA by monitoring the denaturation of double-stranded DNA fragments on solid chips such as synthetic diamond coatings. Denaturation experiments were performed in two different ways: i) Chemically, with NaOH solutions in combination with impedance spectroscopy as readout principle and ii) thermally, using the heat-transfer method HTM. The latter technique measures the thermal interface resistance R_{th} between the chip and the liquid; the R_{th} parameter responds sensitively to all molecular changes at the solid-liquid interface.

Using these two methods, I will address a couple of "real life" biosensing applications such as the detection of the allergen Ara h1 (a protein) in peanut butter, the neurotransmitter serotonin in blood, and histamine in fish brine and intestinal fluids. Histamine is a mediator in the irritable bowel syndrome IBS and we are currently working towards a catheter-based diagnostic tool. Within these applications, polymer-based receptors (molecularly imprinted polymers, MIPs) are playing an advantageous role owing to their long-term stability, chemical resilience under adverse conditions, and their regeneration capacity.

In the final part of the presentation, I will discuss the selective detection and identification of cells (*e.g.* macrophages, cancer cells) and bacteria using whole-cell receptors. These receptors, surface-imprinted polymers (SIPs), are fabricated by soft lithography with stamping of template cells onto polyurethane layers. Special attention goes to the rebinding mechanism between the imprints and target cells and to ways how to boost selectivity by repetitive exposure. Combining these SIP receptors with HTM readout, relevantly low detection limits seem to become feasible. Especially for agriculture, the food industry and in the context of environmental safety, there is a considerable need for fast, on-site techniques to detect pathogenic microorganisms.