New and emerging infectious diseases pose a growing global challenge for patient diagnosis and treatment, and for public health responses. Biosensors are one of the fastest growing technologies for in vitro diagnostics, and the sophisticated microsystems offer exciting opportunities for decentralized clinical applications in medicine and diagnostics. In this PhD project, low cost electrochemical plastic sensors for basic research, diagnosis of viral infections or drug discovery were developed and evaluated.

In the developed biosensor chip, early signs of virus infection in cell culture could be detected electrically using a cell based biosensing platform. The system responded for the infection of human cells within a few hours. This is a highly competitive time frame compared to viral culture, which is still the golden standard for laboratory diagnosis of viral infections.

The biosensing platform was adapted to selectively fish out virions from body fluid by aptamer functionalization. The intact virus particles were captured by immobilized aptamer probes on conductive polymer electrodes, allowing fast and easy electrical detection. The sensor responded rapidly, and showed high sensitivity and specificity. Influenza virus in saliva specimen was detectable within fifteen minutes at a clinically relevant concentration. The device has potential for miniaturization into a cost effective field ready point of care diagnostic system, where the majority of established techniques fail to function outside the specialized laboratory.

Microfluidic cell migration devices, imitating in vivo conditions were developed with success, improving the in vitro experimental setup for basic research and drug discovery.

Polymer biosensors have reached a new level of maturity, and pathogen detection could benefit from the integration of electrical sensors into low cost plastic microdevices pioneering point of care testing. The presented biosensing platforms have potential for scaling up towards high throughput screening, and are adaptable to other applications in medicine and diagnostics, and other fields.