Project title: Thermal immunosensors for early stage cancer diagnosis

Project leader: Professor Thomas Cleij

Function: Group Leader Smart Devices Research Group and Dean Sciences Maastricht University

Collaborators: Dr. Bart van Grinsven (UM), Dr. Erik Steen Redeker (UM), Dr. Hanne Diliën (UM), Dr. Kasper Eersels (UM), Prof. Serge Muyldermans (Vrije Universiteit Brussel, Belgium)

Proposal (250 words):

Introduction:
Immunosensors exploit the remarkable affinity an antibody has for its antigen. However, antibodies are fragile and difficult to incorporate into sensor modules and immunosensors are typically coupled to readout methods that require post-data analysis. This limits their use in high throughput cancer screening. Single-domain antibodies, or nanobodies, may well alleviate the drawbacks associated with traditional antibodies due to their superior chemical and thermal stability. Additionally, the smart devices research group of Maastricht University has developed a thermal readout unit that is able to detect binding events in a fast, low-cost and label-free manner.

Hypothesis and Objectives:
Hypothesis: Nanobody-based thermal immunosensors are extremely suitable for early stage cancer diagnosis

<u>Objectives</u>

- Coupling nanobodies to chip surface
- Testing the sensor in a lab setting
- Benchmark results with gold standard
- Validate optimized sensor in patient samples

Setting and Methods:
The research will be conducted within the labs of the Smart Devices Research group of Maastricht University, located at the high-tech Brightlands Chemelot campus in the Netherlands.. Within the project, the PhD candidate will co-operate with researchers of the Vrije Universiteit Brussel, who will supply antigens and nanobodies for the experiments.

Impact:
Combining the sensitive, low-cost readout method with high-affinity nanobodies will push the sensitivity of the current platform to a higher level and will bring the technology a step closer to a commercial application. As an example prostate specific antigen (PSA) can be used as a model target but the concept can be extended towards other cancer markers.

Requirements candidate: Highly motivated student with good English communication skills and proactive and resolute attitude. The candidate should have a background in life sciences or biomedical engineering and have an interest in multidisciplinary research.

Keywords: Cancer research, biosensor, nanotechnology, biotechnology, nanobodies

Top 5 selected publications:

1. van Grinsven, B; Vanden Bon, N.; Strauven, H.; Grieten,L.; Murib, M.S.; Jimenez Monroy, K.L.; Janssens, S.D.; Haenen, K.; Schöning, M.J.; Vermeeren, V.; Ameloot, M.; Michiels, L.; Thoelen, R.; De Ceuninck, W.; Wagner, P. Heat-Transfer Resistance at Solid-Liquid Interfaces: A Tool for the Detection of Single-Nucleotide Polymorphisms in DNA. *ACS Nano* **2012**, *6*, 2712-2721.

Citations: Google Scholar: 44 Scopus: 36

2. Steen Redeker, E.; Tien, D.T.; Cortens, D.; Billen, B.; Guedens, W.; Adriaensens, P. Protein Engineering For Directed Immobilization. *Bioconjugate Chem.* **2013**, *24*, 1761-1777.

Citations: Google Scholar: 67 Scopus: 52

3. Eersels, K.; van Grinsven, B.; Ethirajan, A.; Timmermans, S.; Jiménez Monroy, K.L.; Bogie, J.F.J.; Punniyakoti, S.; Vandenryt, T.; Hendriks, J.J.A.; Cleij, T.J.; Daemen, M.J.A.P.; Somers, V.; De Ceuninck, W.; Wagner, P. Selective Identification of Macrophages and Cancer Cells Based on Thermal Transport Through Surface-Imprinted Polymer Layers. *ACS Appl. Mater. Interfaces* **2013**, *5*, 7258–7267.

Citations: Google Scholar: 35 Scopus: 31

4. Peeters, M.; Kobben, S.; Jiménez-Monroy, K.; Modesto, L.; Kraus, M.; Vandenryt, T.; Gaulke, A.; van Grinsven, B.; Ingebrandt, S.; Junkers, T.; Wagner, P. Thermal Detection of Histamine with a Graphene Oxide Based Molecularly Imprinted Polymer Platform Prepared by Reversible Addition-Fragmentation Chain Transfer Polymerization. *Sensor. Actuat. B-Chem.* **2014,** *203*, 527-535.

Citations: Google Scholar: 27 Scopus: 25

5. van Grinsven, B.; Eersels, K.; Akkermans, O.; Ellermann, S.; Kordek, A.; Peeters, M.; Deschaume, O.; Bartic, C.; Diliën, H.; Steen Redeker, E.; Wagner, P.; Cleij, T.J. Label-Free Detection of Escherichia Coli Based on Thermal Transport Through Surface Imprinted Polymers. *ACS Sens.* **2016**, *1*, 1140-1147.

Citations: Google Scholar: 6 Scopus: 5