Health chaired by Pascal Jonkheijm/Kerensa Broersen - room 6

14.15-14.30	*Versatile Polymers and Nanoparticles in Controlled Drug Delivery and Targeted Imaging* Jos M.J. Paulusse (BNT)
14.35-14.50	*(Dis)functional membrane remodeling with the intrinsically disordered protein α-synuclein* Mireille Claessens (NBP)
14.55-15.10	*Technical challenges in organs on chip* Loes Segerink (BIOS)
15.15-15.30	*Shooting with a BuBble Gun* David Fernandez Rivas (MCS)

Versatile Polymers and Nanoparticles in Controlled Drug Delivery and Targeted Imaging, Jos M.J. Paulusse (BNT)

Due to their chemical diversity and highly modular nature, polymers and polymeric nanoparticles in particular are popular nanocarrier materials for controlled drug delivery. Most polymeric nanoparticles, however, are in the 50-200 nm size range, which is unfortunate, since proteins, enzymes and some viruses are considerably smaller in size. In order to widen the scope of drug carrier systems and access the sub-20 nm size regime, we are investigating controlled crosslinking polymerization and single-chain polymer nanoparticles as strategies to carefully tune polymer nanoparticle size and achieve optimal control over their biodistribution behavior.

At the same time, we are investigating silicon nanoparticles as multimodal imaging agent. Appropriately sized silicon nanoparticles are well-known for their interesting fluorescence properties. However, due to their unique composition, they are also promising materials for high sensitivity magnetic resonance imaging. We aim at combining these properties in a single particle, making use of our polymer-based nanocarriers to control their fate in the human body and enable disease diagnosis in much earlier stages.

(Dis)functional membrane remodeling with the intrinsically disordered protein α-synuclein, Mireille Claessens (NBP)

Proteins are the workhorse molecules of life and their function has long been thought to be reflected in their folded 3D structure. However, it turns out that a considerable fraction of proteins evades this structure function paradigm. These intrinsically disordered proteins (IDPs) do not possess a unique and persistent structure. It starts to become clear that nature uses these proteins for multiple parallel functions. The versatility and responsiveness of IDPs has a lot of merits. It however comes at a cost, the aggregation of IDPs has been implicated in cell death in neurodegenerative disorders such as Alzheimer's and Parkinson's disease.

Here I will discuss our current understanding of the function and toxic interactions of one of these IDPs; alpha-synuclein (aS). The exact function of this protein is still largely unknown. *In vitro*, it is able to bind

membranes via an amphipathic α-helix which possibly contributes to the remodeling of cellular membranes. The interaction of aS with cellular membranes is however not only functional, it is thought to be critical in the development of Parkinson's disease. In Parkinson's disease aS aggregates into oligomeric structures and amyloid fibrils. The binding of oligomeric aS aggregates to membranes has been associated with pore formation and the (membrane associated) aggregation of aS into amyloid fibrils has been reported to disrupt membranes. The mechanisms by which monomeric, oligomeric and fibrillar aS remodel membranes or disrupt membrane integrity are not well understood. I will show how we used a broad repertoire of quantitative single molecule and ensemble biophysical techniques, to obtain insight into aS function and possible disease mechanisms.

Technical challenges in organs on chip, Loes Segerink (BIOS)
The field of organs on chips is rapidly evolving, from single organ on chip ten years ago, to a body on chip recently. Not only the complexity of different tissues has been increased by creating co- or even multi-cultures; also, other types of cells are nowadays introduced in these systems, like primary cells and induced pluripotent stem cells. On the technical side, also several challenges have been addressed. In this talk we will give an overview of some recent advances made at this university, focusing on membrane development, multiplexing and integrating of electrodes for transendothelial electrical resistance. Besides that, we are currently also working on a standardized organ on chip platform, the TOP platform, which consists of a fluidic circuit board and microfluidic building blocks. By combining this board with different building blocks, one can design the organ on chip with the functionality the researcher has in mind.

Shooting with a BuBble Gun, David Fernandez Rivas (MCS)
The idea of needle-free injection is not new, yet at the MESA+ Institute we have demonstrated that a safer and portable microfluidic injector has the potential to revolutionize diabetes care, permanent make-up and popular tattoos. The alternatives available, e.g. hypodermic needles for traditional injections or tattooing needles increase treatment costs and contaminate the environment and can cause serious health complications.

We are working towards a portable and energy efficient injector to deliver different liquids, in particular insulin. This miniaturized injector can be further developed into a hand-held device or coupled to existing wearable equipment such as insulin pumps and artificial pancreas.

I will shortly describe the goals of an ERC Starting grant with the title BuBble Gun, which will "be aimed" at studying the energy partition between the creation of bubbles, the formation of liquid jets, and the penetration of these jets into soft substrates. This project has the ambition to advance the knowledge at the intersection of microfluidics, physics, and bioengineering, to enable unprecedented control over cavitation, jetting, and injection phenomena. The ultimate result will be the predictable, reproducible, and efficient injection of liquids that will enable a wide-range of technologies, such as additive manufacturing, coating modifications, the delivery of drugs and vaccinations.