>>> ANNOUNCEMENT

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Integrating microtechnology, microbiology, and tissue engineering: From bacterial adhesion studies to organs-on-a-chip platforms

ABSTRACT

By combining microfabrication and microtechnology with biological cells and tissue, new powerful opportunities for both fundamental research and technological applications open up. In this talk, I will introduce two different research projects connected by the same underlying idea of integrating microtechnology and biology: i) The modification of AFM-cantilevers with pathogenic bacteria to determine quantitative values for bacterial adhesion, and ii) the integration of human tissue into microfluidic devices to obtain organ-on-a-chip platforms. In the first project we studied various aspects of the adhesion of bacteria to inorganic surfaces, which is of upmost importance for various biomedical applications. To characterize bacterial adhesion, we fabricated bacterial probes by attaching living single bacteria or clusters thereof to AFM-cantilevers of different geometries using various adhesive molecules. AFM force-spectroscopy experiments with these bacterial probes enable quantitative force measurements in the range of nN. Using this method, we were able to unravel the impact of subsurface and surface properties of a material and to reveal for the first time that the composition of the material beneath the surface can have a significant effect on the adhesion of bacteria. Besides fundamental research, this method also allows for application-oriented studies, such as characterizing the effect of fluoridation of teeth surfaces on the adhesion of oral bacteria.In the second project we combined microtechnology with tissue constructs derived from human induced pluripotent stem (iPS) cells to create organ-on-a-chip platforms. These platforms, based on microfluidic devices, can simulate 3D tissue structure and function, and create organ-like structures. Using microfabrication techniques we have developed a 3D microphysiological platform that mimics the linear structure of the perimysial collagen fibers in human cardiac tissue and is amenable to high-content drug screening. The platform is able to create an aligned, 3D cardiac micro-tissue that is functional with physiological beat rates (60-80 bpm) and viable for multiple weeks. We validated function of the cardiac micro-tissue by assessing the physiological response to various cardiac drugs. The developed microphysiological platform is extremely versatile and can be used for drug toxicity screening, fundamental research, and therapeutic applications. It has the potential to significantly enhance drug discovery and development, which has to date relied on animal models.

BIO

Since 1/2013	Postdoc at the Biomaterials & Tissue Engineering Laboratory Prof. Dr. K. Healy, Departments of Bioengineering and Materials Science & Engineering University of California at Berkeley, CA, USA
2012	Ph.D. in Physics (summa cum laude): thesis title: “Unraveling the impact of subsurface and surface properties of materials on biological adhesion – a multi-scale approach” Supervisor: Prof. Dr. K. Jacobs, Saarland University, Germany
2009-2012	Ph.D. student and research assistant, Soft Condensed Matter Physics Laboratory of Prof. Dr. K. Jacobs, Experimental Physics, Saarland University, Saarbrücken, Germany
2008-2009	Diploma (M.Sc.) in Physics, Saarland University, Diploma thesis title: “The influence of long-range van der Waals-forces on bacterial adhesion – an AFM study” Supervisor: Prof. Dr. K. Jacobs
2004-2009	Student at Saarland University, Saarbrücken, Germany

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