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Intracellular calcium ion signaling dependent on surface properties of biomaterials

Susanne Staehlke, Henrike Rebl, Martina Gruening and **Barbara J Nebe**
University of Rostock, Germany

The first critical courses for assessing the suitability of a new biomaterial in medicine are biofunctionality and compatibility of the biosystem at the site of its effect. Topographical as well as chemical surface properties of biomaterials have a specific impact of integration and regeneration in bone tissue. The surface stimuli can affect the cell behavior, either detrimentally or favorably. So, the osteoblasts recognize their surrounding by adhesion receptors connected intracellularly with focal adhesion complexes. The associated intracellular actin cytoskeleton is in control for cell morphology, migration as well as for the transmission of signals and forces of the surroundings into the cells. External signals from physico-chemical environments finally influence the cell function (Figure 1). However, it is unclear as to which physiological processes will be affected in detail. In the previous studies, we could find out that defined geometrical micro-pillars influenced the cell architecture and the cell function of human MG-63 osteoblasts. In addition, the mobilization of intracellular calcium ions (Ca^{2+}) after ATP stimulus was significantly impaired in cells growing on micro-pillars. It raises the question whether the mobilization of intracellular Ca^{2+}, as "second messenger", represents a sensitive parameter for *in vitro* studies of cell-biomaterial interactions. In our recent studies we examined the cell physiology and signaling on different chemical properties of biomaterials. The data indicate an increased intracellular Ca^{2+} signaling on plasma-chemically modified titanium with improved cell adhesion and spreading. The understanding of complex cellular behavior and intracellular signaling events is critical for the acceptance of new biomaterial surfaces in regenerative medicine.

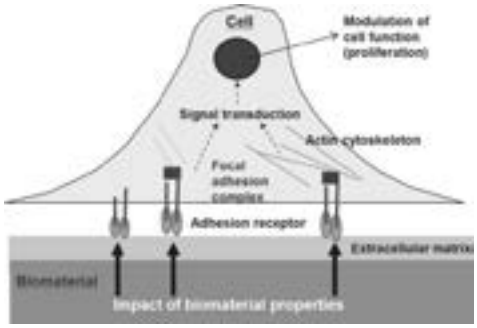

Figure 1: Scheme of the interaction of cells with biomaterials

Recent publications

1. Moerke C, Mueller P and Nebe B (2016) Attempted caveolae-meadiated phagocytosis of surface-fixed micro-pillars by human osteoblasts. Biomaterials 76:102-114.
2. Staehlke S, Koertge A and Nebe B (2015) Intracellular calcium dynamics in dependence on topographical features of titanium. Biomaterials 46:48-57.
3. Rychly J and Nebe B (2013) Cell-material-interaction. BioNanoMat. 14:153-60.
4. Matschegewski C, Staehlke S, Loeffler R, Lange R, Chai F, et al. (2010) Cell architecture-cell function dependencies on titanium arrays with regular geometry. Biomaterials 31(22):5729-40.
5. Luethen F, Lange R, Becker P, Rychly J, Beck U, et al. (2005) The influence of surface roughness of titanium on β1- and β3-integrin adhesion and the organization of fibronectin in human osteoblastic cells. Biomaterials 26:2423-40.

Biography

Susanne Staehlke earned her Diploma in Genetic and Microbiology at the University of Rostock, and went on to earn her PhD at the University Medical Center Rostock, Dept of Cell Biology, Germany, studying the interaction of human osteoblasts with defined microtopographical features of titanium-cell architecture und signaling. She is now a young researcher completing her Post-doctoral training at the University Medical Center Rostock, Dept of Cell Biology. She is a Member of the German Society for Biomaterials (DGBM) and got DGBM Poster awards in 2011 and 2013. She is skilled in western blot analysis, immunofluorescence, biomedical science, flow cytometry, cell signaling and confocal microscopy. She has published over 10 papers and has given several invited presentations at international meetings around the world (Hong Kong: ICBB 2012, Minneapolis: BioInterface 2013, Oslo: ScSB 2013, Rytro: PSBM 2016 and 17, Xian: CMCB2017, Bordeaux: FiMPART 2017).

susanne.staehlke@med.uni-rostock.de

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