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Microfluidic *in vitro* platform for nano-toxicity screening

Within the EU project HISENTS, Fraunhofer IBMT developed a new platform that can be used to simulate the pathway of nanoparticles through the human body. The platform is composed of individual modules each of them representing either a barrier of the body, an organ or subcellular systems. Modules can be run individually or interconnected with each other in a flexible way. This interconnection allows a realistic simulation of the *in-vivo* situation.

Each module of the platform comprises a fluidic system with valves, pumps, tubing and a microfluidic cartridge as the core component. Inside the cartridge an embedded silicon-based microwell with a porous, optically transparent membrane from silicon nitride is employed as a miniaturized incubator. Cells are transported through a microchannel to this microwell and adhere on a 1.5 µm thin, optically transparent membrane, which is made from silicon nitride. Cells are cultivated on the nitride membrane at 37 °C and fresh culture medium is constantly supplied to the cells through the microchannel. The microfluidic cartridge enables barrier formation as well as the positioning of single cells and the exposition to nanoparticles or other test substances. At the end of an assay the nanoparticles and/or metabolites can be collected and analysed or transported from one module to the next.

The cells in the microfluidic cartridge are characterised optically and electrically during cultivation and during their exposition to the nanoparticles. Embedded thin film electrodes in the two microchannels of the cartridge are connected with an impedance measurement set-up. Optical characterisation is performed by means of a compact imaging module that was specifically developed for the in-vitro platform.

Cells from different cell lines (e.g. A549, HepG2) were successfully cultivated in the microfluidic cartridge over several days. Cell layers and single cells were exposed to different test substances. Their effect on the cells was analysed by impedance measurement and fluorescence microscopy.

The developed microfluidic platform proved to be a versatile tool for cultivation and analysis of cells in a small microenvironment outside a lab incubator.