The Division of Molecular Biological-Biochemical Processing Technology
University of Leipzig, Leipzig, Germany

The Research
The Division of Molecular Biological-Biochemical Processing Technology (MBPT), led by Professor Andrea A. Robitzki, is located at the Center for Biotechnology and Biomedicine in Leipzig and was founded in 2002. The research of the MBPT group is based on four innovative technology platforms and focuses on (i) the development of cell- and tissue-based biosensors for monitoring processes of electric and nonelectric active cells under high content screening and noninvasive conditions; (ii) laser manipulation technology for the selection and catapulting of cells, as well as laser-based axonal guidance of nerve cells; (iii) the design and fabrication of various chip-based sensors with integrated microelectrodes and/or nano- and microstructured compartments for controlled drug delivery; and (iv) the engineering of three-dimensional (3-D) neuronal tissues for replacement therapies or for assembling sensor chips to carry out functional high content screenings. All these technologies are intended for basic research as well as for applied sciences in order to meet the ambitious demands of the pharmaceutical industry.

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The Technique
Impedance spectroscopy—also known as cellular dielectric spectroscopy (CDS) or electric impedance spectroscopy (EIS)—can be used to measure frequency-dependent alterations of passive electrical properties of single cells or complex tissues by applying defined alternate currents. For our technique, we applied an alternate voltage current to a biological sample whereby the current flows from an active working electrode through and beneath the cell or tissue to a counter electrode. Under these noninvasive conditions, the cell itself acts as a resistor and capacitor affecting the recorded impedance. Depending on the frequency and the dielectric properties of subcellular structures, it is possible to analyze different processes occurring under native conditions or after application of drugs, toxins, or other active compounds. For example, we used PMA-induced cellular alterations, as summarized in our paper. The major goal of our research group in respect of bioimpedance spectroscopy is to design and fabricate novel multimicroelectrode arrays that can be coupled with single cells or complex 3-D tissues for an automated, high content and/or high-throughput screening. We are particularly interested in the identification and functional analysis of biologic active compounds on tumor cells or previously established cell lines and 3-D tissue models by means of impedance spectroscopy.

Real-time measurement of PMA-induced cellular alterations by microelectrode array-based impedance spectroscopy, p. 445.