# FS 117

## Integration of piezoelectric transducers in well plates for broadband acoustic spectroscopy

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The purpose of this research is the integration of acoustic sensors in well plates with PolCarr® carriers for in vitro diagnostics of cells. In this study piezoelectric transducers are used to excite and receive short ultrasonic waves with broad frequency spectra, that interact with the adherent cell culture. The frequency spectrum of the received time signal is analysed to evaluate the condition of the cells. One of the major advantages in comparison to optical techniqes is, that the well plate need not to be removed from the incubator to perform continuous monitoring.
Based on preliminary test with different test liquids and yeast cells, several concepts have been developed and evaluated for the integration of such sensors. Two demonstrator systems are presented based on the most promising concepts.
The first approach is to integrate a set of sending and receiving transducers into the wall of the well, that are directly opposite to each other. These transducers can be used for a transmission technique or a combined transmission and echo technique to analyse the transmitted waves as well as the backscattered. Conventional piezoelectric transducers can be used and therefore the resonance frequencies can vary in the range of 10 MHz to 50 MHz, depending on type and thickness of the transducer material.
The second approach is to deposit a piezoelectric aluminium nitride thin film on the backside of the PolCarr® carrier. In this case it is not possible to distinguish the echos from the substrates surface and the echos from the cell culture or the culture medium, therefore the resonance behaviour of the whole system is analysed. The resonance frequencies are in the range of 100 MHz for the thickness vibration mode, but there is an additional influence caused by the mechanical clamping of the thin film on the substrate.

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## Integrierte Mikrosensorik für induktive-elektrische Breitband-Impedanzspektroskopie

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The talk is focused to inductive-electrical impedance spectroscopy to provide information for monitoring of cell stages or characteristics during the breeding phase. The research is based on the PolCarr® carrier that allows a adherent fixation of cells.
The inductive-electrical impedance spectroscopy allows in comparison to capacitive-electrical impedance spectroscopy a contactless measurement also through a glass tube wall. Due to this, the cells can be left in their breeding environment. Other sources of interference can be kept as low as possible.
First the theory of magnetic properties will discussed. The influence of the cell by which properties during the breeding phase are observed and their interaction in the nutrient solution is described. For this purpose, conductivity solutions with KCl were chosen. Based on this, yeast was observed in a sugar solution. A comparison of the measurement results of the electro-inductive impedance spectroscopy illustrates the differences. In the following presentation, first results on the electro-inductive impedance spectroscopy will be presented, with particular reference to the first measurements at the demonstrator. The further development and integration is shown, which is the basis for an monitoring with microtiter plates.