Abstract

The most frequently used parameter to describe the barrier function in cell physiology (in vitro) and cardiac-vascular system (in vivo) research is the permeability of the cell layer or the wall of blood vessels. There are different methods for „in vitro" environment to measure the permeability in cell cultures. One of the new procedures says that measuring the electric resistance of the confluent cell layers is usable to determine the permeability. In this case the cells are grown on a little gold plate electrode to measure the transcellular electrical resistance (TER). There is only one company (in the USA) producing such instruments (ECIS) which is suitable to measure TER.

Within the scope of this thesis a device has been developed that uses the electrode of the American instrument and is able to measure impedance in several frequency at the same time and store the measured data. The tasks of measurements and signal processing made necessary to build a digital signal processor (DSP) in the equipment. The device contains an ADSP 2181 based EZ-KIT Lite development board able to excite the electrode so the synchronized measurement becomes possible. The measurement is done via the resonator-based generator–observer pair that works in the frequency domain and has been developed for analysing periodic signals. An amplifier of Brüel&Kjaer amplifies the voltage falling the biological sample. On-line measurement tasks (i.e. excitation genaration, operation of the resonator-based observer, averaging and storing the raw data) are done on the DSP, while the user interface and the high-level calculations are running in MATLAB.

The experiences from the measurements carried out on cell layers with the device show that further developments – integrating the analog part into a single card, careful and professional design of the electrode cabling would be essential in further development. Using a floating-point signal processor could increase the measurement accuracy and reliability, as well.

Various methods for the measurement of permeability of cell layers and the electrical model of electrode–electrolyte surface are presented, as well.