MEASUREMENT OF THE ACCUMULATION OF BIOMOLECULES IN A SOLUTION BY MEANS OF PIEZOELECTRIC CRYSTALS

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ABSTRACT

The principle of micro weighing is used to detect minute amounts of biological and chemical substances in liquids. By this micro weighing mass accumulation onto a sensitive layer can be measured, e. g. the accumulation of antigens onto a layer of antibodies.
This paper deals with micro weighing based on the principle of measuring the change of the resonant frequency of a piezoelectric resonator in consequence of the above-mentioned mass accumulation.

EXPERIMENTAL

The measurement system consists of two oscillators, a sensor head and a frequency counter (Fig. 1). A personal computer controls this system and stores the data of the measurement. The correct working of the oscillators is monitored by an oscilloscope.

The sensor head contains two quartz filters. Each of them is equipped with a 25 MHz quartz and an impedance transforming circuit, which is necessary to drive the HF line at the output. This fact facilitates a very small housing of the sensor

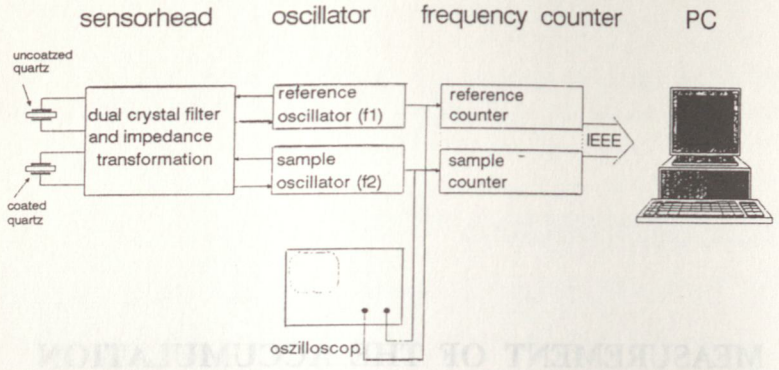

Fig. 1 System for the measuring of mass accumulation

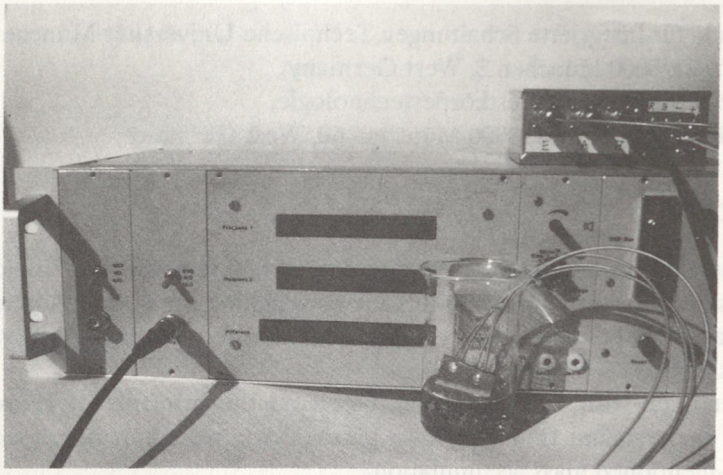

Fig. 2 Sensor head with oscillator and frequency counter

head. The quartzes, determinating the frequency, are placed in the sensor head so that the resonant frequency can directly be influenced by the mass accumulation in

the sample solution (Fig. 2, Fig. 3). With this system mass accumulation can be measured with a maximum sensitivity of a few ng/cm^2.

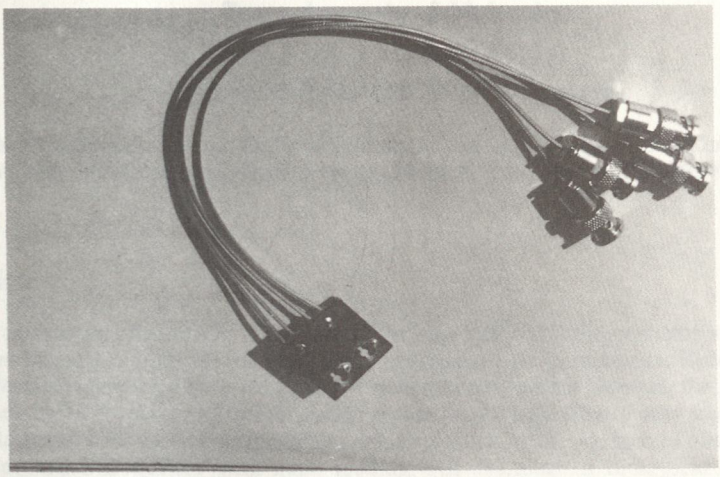

Fig. 3 Sensor head

The oscillator consists of an amplifier with the frequency determinating quartz filter (sensor head) in its feedback. This oscillator can even work in liquids.

With this measurement system the accumulation of streptavidin (10 nM) onto the biotin-covered quartz resonator can be measured, even in a liquid solution. To suppress the influence of disturbances a differential measurement technique is used: One resonator is covered with biotin, the other is uncovered. During the accumulation a decrease of the resonant frequency of 250 Hz can be measured. This decrease is caused by a mass accumulation of about 250 ng/cm^2.

CONCLUSION

The described measurement system for micro weighing even works in sample solutions and is able to detect mass accumulation down to the range of 10 ng/cm^2. This is proved by the measuring of the accumulation of streptavidin onto the biotin-covered crystal.