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Bio-MEMS for Water Analytics

In recent years the sustainable and responsible consumption of drinking and industrial water has evolved to a critical factor. Global climate change will aggravate the situation in some regions of the world. The need to analyse water samples to detect changes in water quality such as chemical, physical and microbiological properties as well as the prove of pollutants and toxic substances will increase.

By law different methods to take and handle water samples are required. Organoleptic characteristics (odour, colour, turbidity, residuum) and physicochemical parameters (pH-value, oxygen and phosphate content etc.) are measured. Also microbiological tests using indicator organisms have to be executed [1].

For artificial bodies of water, such as swimming pools and wastewater treatments analytics with indicator organisms are preferred due to the high degree of purity of this type of water. It is necessary to insert organisms into the samples and to monitor their reactions (DIN 38412) [2]. A high experimental complexity is provoked by this tests. The populations used are not isophaseal, hence results give just an approximate impression about the influence of water quality on their vitality.

To simplify and improve the analysis an early warning system for pollutants and dangerous substances based on microsystem components currently is under development. The microsystems (Bio-MEMS) have to be standardised, robust and low cost. These systems can be installed as a distributed sensor system in the periphery of the public water supply for continuous observation.

For first tests adapted cultivation chambers for biological tests have been developed. They can be used as life support systems for single and multicellular indicator organisms (e.g. *Scenedesmus*, *Tetrahymena*, luminous bacteria, *Daphnia*). Successful long term experiments lasted about 48 hours. Morphological detectable reactions of specimen can be recorded to differentiate between clean and polluted water (Fig. 1).

A convenient way to gain the full effectiveness of significant test methods is the combination of several cultivation chambers to allow multistage experiments. This can

be done by cascading of structures (Fig. 2) or by combinatorial fluidic logic.

The systems presented will enable in-situ observations of single organisms or small and well defined populations as well as of cell cultures in micro-systems.

The moving range of the specimen is strictly restricted to the cultivation chamber with synchronous media support and microscopic observation. Thus, a real-time detection for water pollutants can be established to increase quality and security in water supply systems.

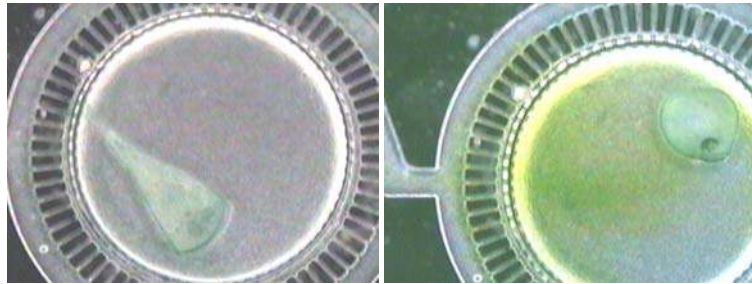


Fig. 1: reaction of an organism in clean (left) and polluted water (right) in the mikrosystem

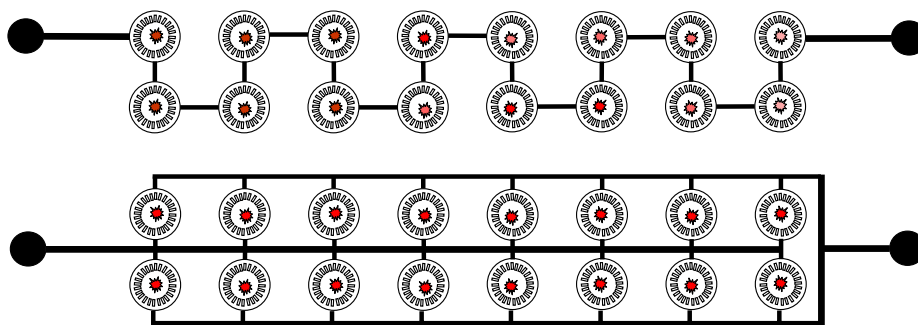


Fig. 2: cascading of cultivation chambers

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