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RESEARCH NEWS

Bioprocessing Technology

Measuring optimally with spheres

Bio-reactors are the cooking pots of biochemists and bio-technologists, in which pharmaceutical agents, enzymes or nematodes are produced for the purpose of biological pest control. A nutrient solution (such as heat, oxygen, acid or alkali) is used to regulate the pH value and the desired product is formed. The more optimal the conditions are, the greater the yield will be. Fraunhofer researchers have now developed spherical probes to more effectively monitor and streamline the manufacturing process.

The right temperature determines how well microorganisms or cells can be cultivated in a bioreactor. Although heat in the reactor is distributed differently, temperature has so far only been able to be measured selectively with rod probes inserted through pre-defined holes. "With our mobile sensor spheres, which are about the size of a pea, we can capture the temperature in many places at the same time. This makes it possible to accurately regulate the heat input so that it is optimal for the production process," says Tobias Lüke, who has developed the new Sens-o-Spheres measuring spheres at the Fraunhofer Institute for Electronic Nano Systems ENAS in cooperation with scientists from the Technical University Dresden and project partners from industry. "At one liter, the temperature differences within a reactor are not that great. However, with several thousand liters, the degree of error increases considerably. With our precise measurement technology, there are fewer problems in upscaling the volumes, which means switching from small test reactors in the laboratory to large ones in the production hall."

No limitations

Another advantage of the Sens-o-Spheres: While rod probes are tied together by cables, the spheres are equipped with a rechargeable battery. "The amount of installation effort is therefore quite low. The Sens-o-Spheres simply float in the medium, so they do not cause any disturbance, such as when stirring. In addition, they can be easily used in kilometer-long tube reactors and other innovative reactor types as well as in classic small cultivation vessels, such as the shake flask."Common measuring systems have their limits in this regard," explains Lüke.

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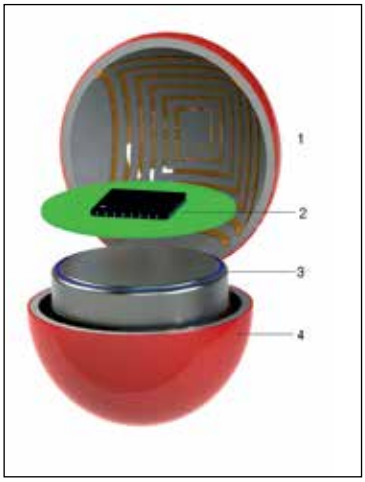
The recorded data is transmitted live via radio to a base station. Each measurement is assigned to a specific sphere, because each has its own ID. The more spheres there are, the more accurate the measurement will be. There is no rule of thumb concerning how many spheres are necessary, though. The approach is to use as many spheres as necessary, and as few as possible.

Easy to reuse

After use, the spheres can be easily sterilized in the so-called autoclave, since the electronics are robust and also securely enclosed by a capsule made of polypropylene – neither moisture nor high temperatures of around 120 degrees Celsius or more (as is usual in autoclaving) can harm it. The spheres can therefore be kept sterile, recharged by means of a specially designed inductive battery charging system, and reused.

Soon, the measuring spheres should be able to detect not only the temperature, but also the oxygen content and the pH value. "We also want to connect the base station to the overall system. Then, the manufacturing process could be automatically controlled based on the measured values. The spheres should also be able to be located so that it is known exactly where the measured value was recorded."

The measuring spheres are not only ideal for microbiological culture and process development in the laboratory, but could also be used in drug production, environmental measurement or screening in the field of medicine.



The structure of the Sens-o-Spheres: 1) Energy receiver, 2) Signal processing, 3) Rechargeable battery, 4) Encapsulation. © TU Dresden| Picture in color and printing quality: www.fraunhofer.de/en/press

With the miniaturized radio transmission inside the sphere, the measured data is transmitted live to a base station. © Fraunhofer ENAS | Picture in color and printing quality: www.fraunhofer.de/en/press