飲み込みセンサーへの生体適合性マイクロ電池の開発と特性評価 Development and characterization of biocompatible microbatteries for powering ingestible sensors 東北大学¹, ⁰シュタウス スヴェン¹, (M1)宮嵜 竜一¹, 雁部 祥行¹, 本間 格¹

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Biocompatible batteries¹ hold promise for many applications—electronic medical implants, health monitoring devices, and environmental sensors. One concrete example is ingestible sensors², that can be employed for regular monitoring of vital body functions such as core body temperature, controlled drug release, and for checking of medication adherence³. Presently, ingestible sensors are usually powered by large batteries that contain toxic electrode materials. As a consequence, the whole system requires encapsulation to ensure safe use, but this also makes the devices difficult to swallow. Moreover, fabrication of the batteries is often based on conventional, macroscale techniques and therefore possesses only limited potential for miniaturization and mass production^{4,5}. There have been examples of microfabrication techniques to fabricate batteries with smaller form factors, but the thin electrodes restrict the operating times of the microbatteries to a few minutes only^{6,7}.

Here we present the development of biocompatible microbatteries, realized by a combination of conventional microfabrication techniques and direct printing of the electrode materials using functional inks. The electrodes of the microbatteries with nominal footprints of 0.7 x 3.2 mm² and consisting of Ag/AgCl cathodes and Zn anodes were fabricated by first depositing Au thin films as current collectors, using standard photolithography followed by metal sputtering. Both the Ag/AgCl cathodes and Zn anodes were then formed by direct printing using a custom-made system. The microbatteries were characterized by galvanostatic testing in simulated gastric fluid at current levels ranging from 2 to 100 μ A. It is anticipated that the presented approach for realizing biocompatible microbatteries can enable more complex battery architectures and also enable smaller footprints, thereby facilitating their integration in future sensor devices aimed at medical and environmental applications.

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