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Food-grade solid-state electrolytes for fully edible EGOFET

Fabrizio Mario Ferrarese[a,b], Alessandro Luzio[a], Mario Caironi[a]
Istituto Italiano di Tecnologia (IIT)[a], Politecnico di Milano[b]
fabrizio.ferrarese@iit.it, alessandro.luzio@iit.it, mario.caironi@iit.it

A new generation of electronic devices, only composed of natural materials, is here envisioned. This strategy may represent a turning point, not only in the design of eco-friendly implantable biomedical devices, but also toward the development of advanced edible electronics[1,2]. Of course, the edible electronics challenge requires an extra effort, consisting in the exclusive use of food-grade materials for all the device components. This implies the selection of food-grade materials ensuring at the same time:

i. effective functionalities, with a view to the development of fundamental components like insulators, electronic and ionic conductors, semiconductors, supporting materials and barriers

ii. easy processability, enabling the implementation of low-cost and eco-friendly manufacturing

iii. thermal, mechanical and chemical stability, allowing the fabrication of devices with reliability and shelf-life compatible to market requirements[3]

One of the most critical aspect of edible electronics consists in the development of stable electrolyte layers, to be implemented as the gating medium within "low-voltage driven" electrolyte-gated field effect transistors (EGOFETs) and electrochemical transistors (ECT) architectures. In this work, a thorough investigation of the electrical properties of a selection of polysaccharides-based and protein-based films is reported. Different film processing and device integration strategies were effectively accounted, from printing to lamination-like. By tuning the film composition and selecting the adequate processing strategy we were able to demonstrate stable electrolyte gates, efficiently interfacing with a selection of edible and likely edible semiconductors within EGOFET devices and eventually suitable for self-standing architectures.

The present work represents a concrete step toward the realization of low-cost, low-voltage edible electronics, for food-market and in-body pharmaceutical application.

References

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