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FLEXIBLE ELECTRONICS BASED ON POLYELECTROLYTES

Ivanov A.S.[1], Nikolaev K.G.[1]
Research supervisor – Dr. Prof. Skorb E.V.[1]
[1] ITMO University,
Lomonosova, 9, St. Petersburg, 191002, Russia

These days, new approaches are being intensively developed to create flexible electronic components. One of the promising materials used for this purpose is the eutectic alloy of gallium and indium. In this article, chemical systems based on this alloy and polyelectrolytes that simulate the behavior of several electronic components (resistor, capacitor, diode, memristor) are presented.

Flexible electronics have several significant advantages over traditional electronic components. Production processes are cheaper and more straightforward, and mechanical properties (lightness and deformability) significantly expand the application. At the moment, printed electronic components are widely used; however, the search for new methods and approaches to the construction of soft components continues. One of the promising areas is the use of eutectic gallium alloys (eGaIn) combined with gels doped with various substances.

In our research, we used an eGaIn to form electronic component interface. For the contact of these electrodes the agarose gels doped with polyelectrolytes and phosphate buffer saline were prepared. For the experiments, the pH range was varied from 4.8 to 6. Then, using the source measurer unit Keithley 6430, the current-voltage characteristics of the obtained system were recorded. According to the obtained curves, it is possible to make a conclusion about the formation of a proper electrical component. It was experimentally revealed that the behavior depends on the thickness of the layer of gallium oxide and phosphate, which is formed between the surface of electrodes and the gel. The layer thickness depends on the applied voltage. By switching the voltage range from 20 mV to 5 V, a resistor, capacitor, diode, and memristor were obtained. The thinnest layer of insoluble gallium compounds corresponds to a capacitor, and the thickest to a memristor; intermediate states are responsible for the appearance of resistor and diode behavior. The main contribution to the change in behavior was made by using 0.07 M phosphate buffer solution since its addition accelerates the formation of an insoluble phosphate layer. The adding of polyacrylic acid (PAA) and polyethyleneimine (PEI) into the system led to the more accelerated formation of gallium ions. As a result, a thick layer of insoluble gallium compound forms faster, and a transition to a memristor state becomes earlier. Thus, changing the voltage, it is possible to control the response of the system.

In conclusion, it can be noted that electronic components based on a soft substance consisting of a hydrogel and a liquid metal (eutectic gallium indium, EGaIn) were obtained. By varying the thickness of the insoluble phosphate layer at applied voltage, various electrical behaviors can be obtained in a single chemical system. These chemical systems are safe and cheap, and after developing the necessary design, such electronic components can be used for biocompatible devices.

Ivanov A.S. (author)

Skorb E.V. (research supervisor)