UDK 547

DNA-BASED SELF-ORGANIZING STRUCTURES IN A HYDROGEL MATRIX

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Annotation. This paper reports on a new approach to the formation of a two-dimensional pattern based on the hybridization reaction between two complementary DNA sequences in a thin layer of acrylamide gel used as a platform for applying samples. The influence of magnesium ions in the system was also investigated, which, when varying its concentration, gives a more intense fluorescence response.

Introduction. Deoxyribonucleic acid is not only the central macromolecule in living organisms that provides the transmission and storage of genetic information, but can also serve as a building block for many materials [1]. Thanks to the programmed growth and self-organization of DNA molecules, it has become possible to develop unique platforms that are characteristic of biological systems with the formation of patterns [2]. Synthetic biology plays a key role in the approach to biomimetic cell structures. This expands the possibilities of research, which leads to the expansion of the functionality of such materials [3].

However, it still remains a difficult task in reproducibility of such structures caused by the selection of the necessary parameters [4]. Recent studies have led to the fact that synthetic DNA immobilized on a gel polymer forms tunable patterns with switchable signals.

As a model system, artificial DNA samples are used in the work, which simulate the arbitrary dynamics of the reaction of interaction between two DNA molecules. These reactions are based on specific binding, in which the DNA chain is lengthened and also organized into a two-dimensional pattern in the form of a lattice structure in a thin layer of acrylamide gel. This behavior is caused by the fact that stable hydrogen bonds are formed during self-assembly of DNA nanostructures. Since the study of patterns cannot be detected in visible light, a fluorescent dye capable of qualitatively determining the assembly control was used. In addition, it was suggested to change the parameters by adding another component to the system – magnesium chloride, which affects the structure of DNA, acting on the principle of a protective mechanism and increasing the rigidity of the coupling of two DNA sequences, which leads to an increase in fluorescence yield.

Conclusions. Thus, the newly developed reaction-diffusion model in a thin hydrogel layer is a promising material for the immobilization of DNA, which is transformed into a two-dimensional pattern. This allows us to investigate such a model for possible development of biosensor platforms that are based on selective adsorption of various biomolecules, but also the ability to immobilize catalysts, which can significantly increase the binding coefficient of such biomolecules. In the future, it is planned to use a similar platform for delivering nucleic acids to cells, which significantly expands the potential use of the material.

Used Literature

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