საქართველოს მეცნიერებათა ეროვნული აკადემიის მოამბე, ტ. 8, №2, 2014
BULLETIN OF THE GEORGIAN NATIONAL ACADEMY OF SCIENCES, vol. 8, no. 2, 2014

Medical Science

Electrochemically Controlled Removal of Free Hemoglobin from Blood Plasma

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ABSTRACT. Selectivity of carbon nanosorbents can be achieved by the development of a special procedure and a technique for mixing the components (including activated carbons, porous carbonized materials, onion-like carbon nanoparticles and the bonding agent) by compression and thermal treatment under specific conditions that ensure formation of pores of suitable sizes. Upon completion of the preliminary experiments, the effectiveness of the proposed method has been demonstrated. *© 2014 Bull. Georg. Natl. Acad. Sci.*

Key words: *hemoglobin, polarization, electrochemically controlled, nanoporous activated carbon.*

Presently, centrifugal separation is the primary method used for blood preservation. Destruction of a fraction of erythrocytes during centrifugation is quite likely, leading to possible contamination of plasma by free hemoglobin. Besides, hemolysis due to certain diseases can complicate the autotransfusion of blood plasma to a patient (e.g. in cases of large hemorrhages). Removal of free hemoglobin from blood plasma remains an unsolved problem to date. Addressing this problem is the goal of the proposed project.

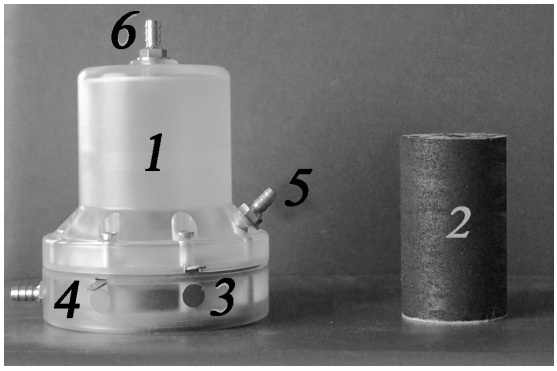

Fig. 1. Device for electrosorption. 1 – casing, 2 – activated carbon cartridge containing onion-like carbon nanoparticles, 3 – working electrode, 4 – counter electrode, 5 – inlet for biological media, 6 – outlet of biological media.

Electrochemical methods can be used to develop controlled medical technologies based on nanocarbon sorption materials. Polarized sorbents containing onion-like carbon nanoparticles can operate in selective regimes. Such flexible technologies are suitable for purification of biological media from free hemoglobin in the regime of controlled affinity sorption. No similar methods are currently known, either in Russia or in other countries.

Selectivity of carbon nanosorbents can be

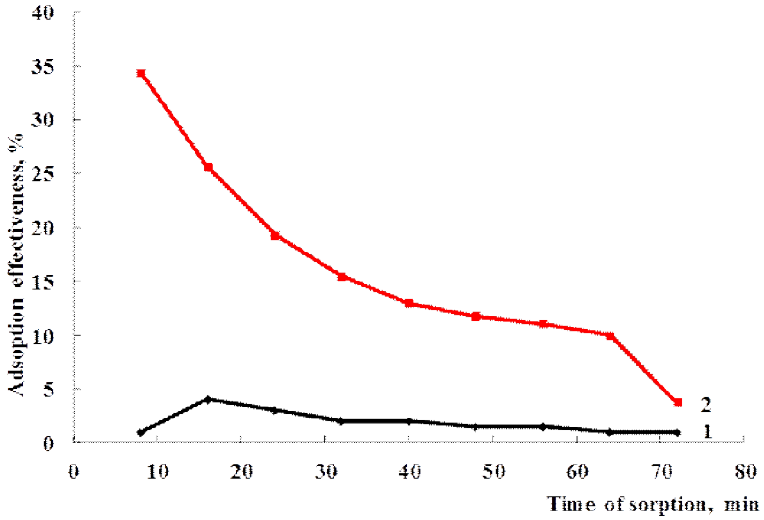

Fig. 2. Time dependency of adsorption effectiveness. 1 – unmodified activated carbon, 2 - activated carbon modified with onion-like carbon nanoparticles.

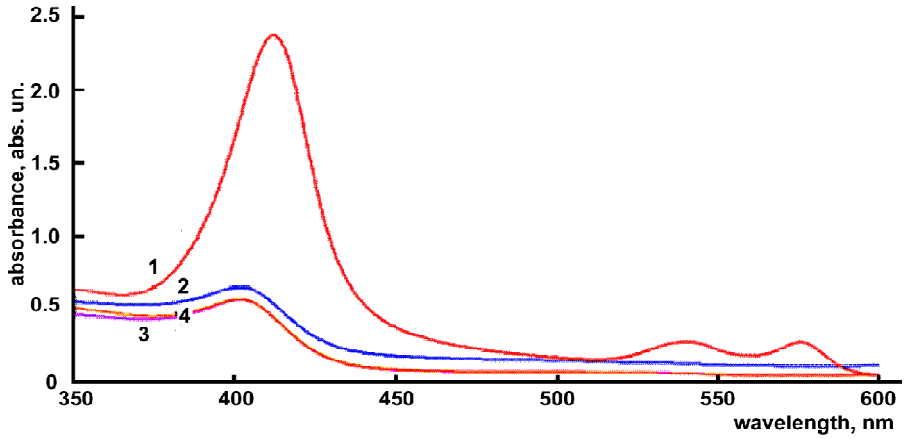

Fig. 3. Spectra of hemoglobin during adsorption: 1 – initial, 2 – after 15 min, 3 – after 30 min, 4 – after 60 min.

achieved by the development of a special procedure and a technique for mixing the components (including activated carbons, porous carbonized materials, onion-like carbon nanoparticles and the bonding agent) by compression and thermal treatment under specific conditions that ensure formation of pores of suitable sizes.

The objects of the development efforts are medical carbon nanosorbents and a method for their production, including the process of cartridge production from sintered porous carbon materials (activated carbons or carbonized materials with onion-like carbon nanoparticles) (Fig.1).

Finally, a range of conditions for polarization of nanocarbon electrodes must be identified, leading to optimal electrosorption regimes for removal of free hemoglobin from biological media.

Incorporation of onion-like carbon nanoparticles in active carbon composition increased the electrosorption efficiency of free hemoglobin (Fig. 2). It can be attributed to the effect of onion-like carbon nanoparticles on the structure of the sorbent.

A decrease in free hemoglobin content was detected as a result of the treatment of free hemoglobin-containing plasma in the device for electrochemical purification (Fig. 3). The adsorbent became saturated after 15-30 minutes of the purification process.

Upon completion of the preliminary experiments, the effectiveness of the proposed method has been demonstrated.

სამედიცინო მეცნიერებანი

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Received June, 2014