SYNTHETIC ACTIVE CARBONS WITH IMMOBILIZED COMPLEX COMPOUNDS

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Introduction

Chemical compounds with encapsulated transitional metal ion in the volume cavity of macropolicyclic ligand are known to be the effective catalysts for photochemical and oxidation-reduction processes, electron transferrers, anion and cation receptors [1]. Therefore, complexes with encapsulated metal ions are of great attraction for the modelling of the important redox biological systems.

It is experimentally well stated fact, that an alterations in surface chemistry of carbon materials affect their electrochemical properties and catalytic activity in oxygen containing solutions. On the other hand, it is known that a wide range of toxic biological molecules in blood can be oxidized by means of external anodic potential at platinum and carbons electrodes [2,3].

Taking into account merits and demerits of synthetic active carbons used as a remedy for the prevention of health disterbunces and unique properties of macrobicyclic complexes with encapsulated transition metal ion and porphyrin derived compounds an approach for producing of proper modified carbon materials which are of biological and medical interests have been studied. The catalytic ability of active carbons with immobilized iron (II) symmetrical macrobicyclic clathrochelates, Iron(II) porphyrin derived compounds and active carbons promoted with palladium have been investigated to catalyze the reaction of oxidation of bilirubin in blood plasma of patients with hepatic diseases. The data were compared with direct electrochemical oxidation of bilirubin on the surface of active carbons polarized from external power source.

Experimental

Synthetic active carbons of SCNs type prepared from synthetic polymers and resines were used. The modified carbon were obtained by the following ways:

SCN-1KCCh and SCN-1KoCCh -by adsorption of symmetrical iron(II) macrobicyclic clathrochelate on the surface of proper carbon granules from clathrochelate saturated solution of acetonitrile;

SCN-1KProph - by impregnation of iron(II) porphyrine complex from biological solution followed by heating of dried up carbons to a temperature of 850^0 C in an argon gas steam;

SCNPd - by chemical reduction of palladium in the volume of carbon granules [4].

SCNpl-nonporous analogue of active synthetic carbons.

SCNplo, SCN-1Ko-oxidized specimens of active synthetic carbons.

The experimental system used both for the estimation of fixed electrode potentials in sodium chloride electrolyte solution and for the determination of catalytic ability of the above mentioned sorbents was the electrochemical cell working on the principles of "boiling layer" connected to a measurement circuit. Specific feature of this system have been described previously [5,6]. Polarization of fluidized-bed carbon electrode held in place of cylindrical compartment was achieved with the help of external power source through the platinum current collector. A silver chloride standard electrode was used as a reference electrtode.

The series of clinical experiments was carried out on patients plasma blood of hepatic diseases after plasmaphereses procedure.

Results and Discussion

Figures 1 and 2 show values of fixed electrode potentials in the volume of fluidezed-bed electrode based on the carbon and modified carbon adsorbents versus pH value of physiological solution. The potential formation on the surface of modified with iron(II) macrobicyclic and iron(II) porphyrin derived complexes active and oxidized carbon adsorbents

occured mainly by electrochemical 4-electron mechamism of molecular oxygen reduction. An alteration of delocalized electron number caused by presence of complex compounds affect their electron donor ability and catalytic activity in the reaction of peroxide decomposition. Surface modification of carbon adsorbents with mentioned complex compounds was found to increase their pH stability in neutral and basic electrolyte solutions in contrast to the limited pH stability of synthetic carbons modified by transition metal ions [6].

The catalytic ability of prepared carbons in the reaction of oxidation of bilirubin(BR) in patients blood plasma has been examined. The results are represented in figure 3 in comparison with direct electrochemical oxidation of bilirubin($E_{ex.pot.}$=+0.8V) on the surface of carbons polarized from external power source.

Conclusion

The preliminary investigations have shown that active and oxidized synthetic carbons with immobilized iron(II) complex compounds possess high catalytic activity in the reactions of hydroperoxide decomposition and oxidation of bilirubin as it was observed in the cases of palladium promoted active carbons catalysts and direct electrochemical oxidation by means of the external electric potential. Surface modification of synthetic carbons as well as electrochemical polarization by applied external potential provide a unique way to improve their detoxification properties in biological fluids. The method of preparation of these modified carbon materials is accessible. So, the results of present study suggest carbon materials with immobilized complex compounds to be the perspective catalytic materials for the redox reactions in electrolyte solution and biological fluids.

References

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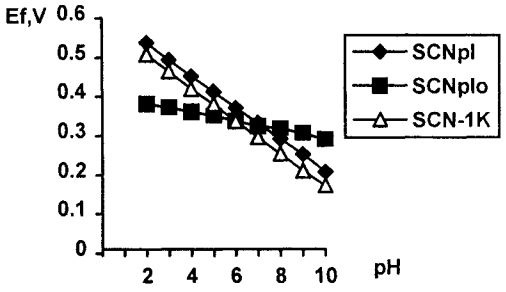

Figure1. Fixed electrode potentials vs. pH values

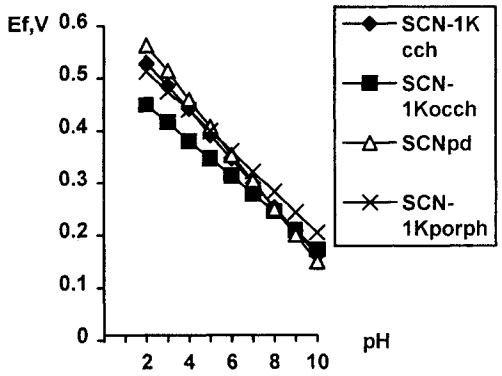

Figure2. Fixed electrode potentials vs. pH values

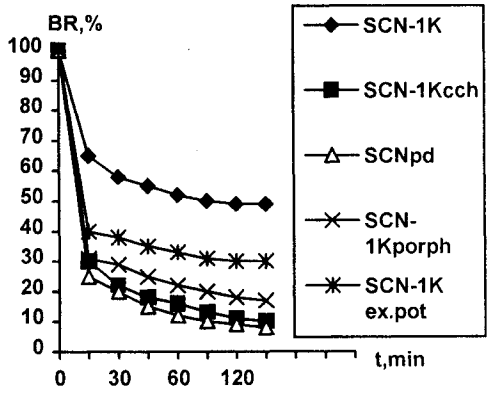

Figure 3. Kinetic kurves of oxidation of bilirubin in blood plasma