RESEARCH OF MAGNETIC CHARACTERISTICS ELECTROCONDUCTIVE POLYANILINE

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Abstract: *in article is considered about receiving and characterizing of various forms of the carrying – out polymer – polyaniline. Curve magnetizations of the received forms are investigated. It is revealed that in the oxidized form material shows a magnetic hysteresis at the room temperature. For polyaniline without special alloying with magnetic additives such result is received for the first time. In article the fact that the polymeric chain of electro conductive polyaniline consists of regularly alternating benzene rings and nitrogen – containing groups is also considered. Such structure of a chain provides polyinterface. Structural formulas of various forms of polyaniline it is presented in the drawing. In the real work magnetic properties of the polyaniline which underwent various chemical treatment at a post – polymerization stage and being in various conditions of oxidation and protonation are investigated.*
Keywords: *polymer, polyaniline, magnetic properties, electric conductance, composition, polymeric chain, magnetics, oxidations, backs, structure, benzene collets.*

ИССЛЕДОВАНИЕ МАГНИТНЫХ ХАРАКТЕРИСТИК ЭЛЕКТРОПРОВОДЯЩЕГО ПОЛИАНИЛИНА

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Аннотация: *в статье рассматривается получение и дается характеристика различных форм проводящего полимера – полианилина. Исследованы кривые намагниченности полученных форм. Обнаружено, что в окисленной форме материал демонстрирует магнитный гистерезис при комнатной температуре. Для полианилина без специального легирования магнитными добавками такой результат получен впервые. В статье также рассматривается то, что полимерная цепь электропроводящего полианилина состоит из регулярно чередующихся бензольных колец и азотсодержащих групп. Такая структура цепи обеспечивает полисопряжение. Структурные формулы различных форм полианилина представлены в рисунке. В настоящей работе исследованы магнитные свойства полианилина, прошедшего различную химическую обработку на постполимеризационной стадии и находящегося в различных состояниях окисления и протонирования.*
Ключевые слова: *полимер, полианилин, магнитные свойства, электропроводимость, композиция, полимерная цепь, магнетики, окисления, спин, структура, бензольные кольца.*

Organic magnetics (or otherwise molecular magnetics) stopped being exotic at the end of the last century. Rather wide range of organic highly spin materials on the basis of complexes with charge transfer [1] and radicals of a nitroksid was received. Also, as structural elements of organic magnetics aromatic amines were used. Recently magnetic properties of the high-molecular polyinterfaced connections – electro conductive polymers are intensively investigated.

It is shown that representatives of this class – polyaniline, polypirrole, the polythiohair dryer possess intensive spin-spin interaction and are perspective for creation of high-molecular organic magnetics. Development of materials of this type not only is supported by interest in fundamental problems of magnetism, but also is a part of the general process of search of new materials with an unusual combination of the properties providing new opportunities for the equipment and technology. A research object in the real work was the organic semiconductor the polyaniline relating to high-molecular aromatic amines.

The polymeric chain of electro conductive polyaniline (PANI) consists of regularly alternating benzene rings and nitrogen-containing groups (fig. 1). Such structure of a chain provides polyinterface (regular alternation of unary and double communications).

The polymeric chain forms the zigzag lying in one plane, at the same time clouds π – electrons are blocked over and under the chain plane. Carriers of a

charge are formed in such polymer at its oxidation. As the centers of oxidation of the PANI serve the nitrogen atoms having couple of electrons which is not involved in chemical valent bonds. At oxidation, i.e. withdrawal of one of electrons, in a polymeric chain the positive charge appears. Removal of one of electrons of couple means formation not coupled a back. Existence of such spin in material also results in the PANI uncommon magnetic properties. Content of the oxidized nitrogen atoms in the PANI can change from zero (that corresponds got into condition a leykoemeraldine) almost to unit (the highest oxidation level – pernigraniline). Most the PANI stable form is emeraldine where every second atom of nitrogen (fig. 1) is oxidized.

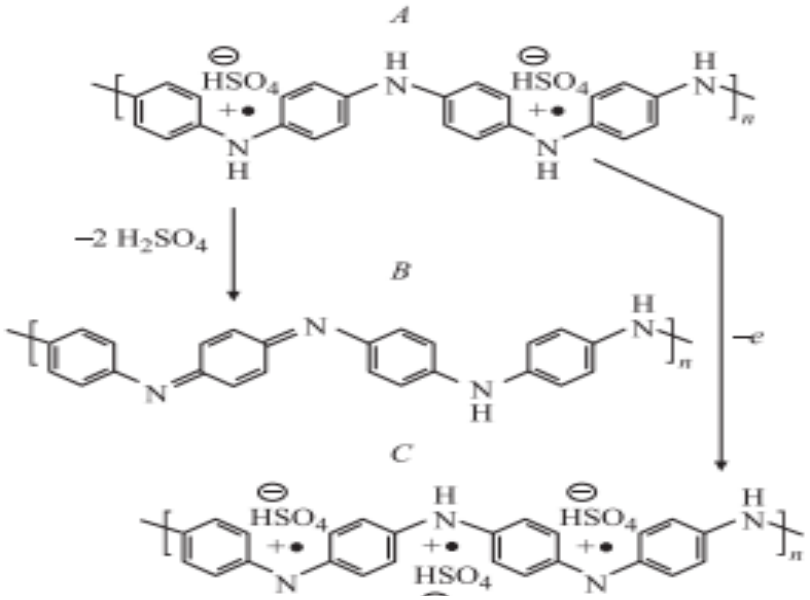

Fig. 1. Structural formulas of various forms of polyaniline. The A-protonated emeraldines form containing a half of the oxidized atoms of nitrogen, B – deprotonated emeraldine with the smallest concentration of spin, C — the protonated PANI pernigranilines form where more than a half of atoms of nitrogen are in the oxidized state

Fat points are not coupled electrons which are not participating in covalent communications. Pluses are symbolized by existence of the effective *positive charge (hole) localized on nitrogen atom as a result of its oxidation.*

The positive charge arising at oxidation in the main chain has to be compensated (in chemical terminology it is stabilized) by an antiion. The best stabilizers of carriers of a charge of the PANI are strong acids. Anion of acid is connected by Coulomb interaction with the electronic hole formed at oxidation (i.e. during removal of an electron). Interaction of the PANI with acid is reversible and is called protonation. Removal of the stabilizing acid (deprotonated) leads to decrease in conductivity and concentration of not coupled spin.

Oxidation processes – restoration and protonation – a deprotonated of the PANI are reversible. It creates variety of the forms of polymer having various properties.

In the real work the PANI magnetic properties, the oxidation which underwent various chemical treatment at a post-polymerization stage and being in various states and protonation are investigated.

By preparation of samples much attention was paid to purity of initial reagents, care of carrying out synthesis and the subsequent operations, on purpose not to allow pollution of samples magnetic impurity and not to change morphology of the studied material. It is especially important when studying weak magnetism of the obscure nature. In our opinion, a comparative research of the same initial material which magnetic properties change at the chemical influence which is not bringing impurity and not changing material morphology, most reliably. At synthesis of the PANI and its post-polymerization processing metal ware and devices were not used. Samples were stored and transported in tight plastic packing.

Polyaniline is received by method of oxidizing polymerization of aniline [2]. Equal volumes of solutions of aniline (0,2 M) in sulfuric acid (0,2 M) and ammonium sulfate peroxide (0,25 M) in water mixed at the room temperature. Within 10 min. in a reactionary flask there was an exothermic reaction which was followed by change of coloring of the reactionary environment and loss of a dense black-green deposit of polymer.

The protonated PANI emeraldines form was the main product of polymerization. Synthesis by-products, sulfate of ammonium and sulfuric acid and also small amounts of oligomer of aniline were removed repeated washing of a deposit in acidic water environments and methanol. An exit of polymer made 95-98%.

The research of the PANI various forms by EPR analysis methods with use of an organic standard of spin density showed that the maintenance of not coupled spin depends on oxidation level and protonation of polymer [3].

The experimental results received in the real work raise the questions on which there are only presumable answers so far. Is even more problematic to offer an overall picture of the phenomena and interactions shown in an experiment.

In article the possibility of management of magnetic properties of the carrying – out polyaniline by means of chemical treatment of polymeric material is shown. The nature of the influences changing magnetic properties was not connected with introduction of magnetic additives that proves own nature of magnetism of polyaniline. At the same time concerning the mechanisms responsible for magnetism of polyaniline, only the hypothetical assumptions can be made. The bigger number of the parameters necessary for characterization of polymeric material, in comparison with traditional solid-state objects is essential

(for example, conformational characteristics of polymeric chains) leaves, in our opinion, an opportunity for many assumptions and demands a further research.

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