Electroconductive polymer films obtained by plasma polymerization of 1-amino-9,10-anthraquinone

*A. I. Drachev, E. I. Shklyarova, T. V. Dorofeeva, A. B. Gil´man, and A. A. Kuznetsov**

N. S. Enikolopov Institute of Synthetic Polymeric Materials, Russian Academy of Sciences, 70 ul. Profsoyuznaya, 117393 Moscow, Russian Federation. Fax: +7 (095) 420 2229. E-mail: plasma@ispm.ru

Polymerization of aniline, pyridine, and thiophene in the high-frequency discharge plasma was used for the preparation of thin polymeric films possessing semiconducting properties.[1—4] The bulk conductivity of the nondoped samples did not exceed 10^{-9} Ohm^{-1} cm^{-1} and only after doping reached 10^{-5}—10^{-4} Ohm^{-1} cm^{-1}.

In this work, polymeric films based on 1-amino-9,10-anthraquinone (AA) were synthesized by polymerization in dc discharge.

Polymerization was carried out in a vacuum tubular reaction chamber of 30 cm length and 10 cm diameter. The upper part of the chamber was placed in an electric furnace, which provided heating to 400 °C controlled by a thermocouple. Two horizontal planar-parallel electrodes with a diameter of 50 mm were placed in the chamber, and a ceramic cup with the starting substance was placed on an anode. Polymerization was performed for 5—120 min at 160—300 °C in a discharge current of 5—15 mA at a pressure of 10^{-3}—10^{-1} Pa.

A black film with a thickness of 1—9 μm (according to the data of electron scanning microscopy) was obtained on a cathode. The film is insoluble in organic solvents and has a high bulk conductivity (10^{-5}—10^{-4} Ohm^{-1} cm^{-1}) and a surface conductivity (10^{-14} Ohm^{-1}) typical of dielectrics. This anisotropy of the electric properties is related, most likely, to anisotropy of the morphological structure of the polymer that formed. XPS study showed that the film did not differ in element composition from the initial AA. A red film precipitated on the anode with thickness ≤1 μm was soluble in acetone and represented a dielectric with a conductivity of 10^{-16} Ohm^{-1} cm^{-1}.

The ESR spectrum of the film precipitated on the cathode exhibited a singlet with the *g* factor close to that of a free electron. The concentration of paramagnetic centers was 10^{18} sp g^{-1}. The magnetic properties were studied at room temperature using a magnetic balance by the Faraday method. The design and procedure of measurements were described in detail.[5] The weight of the studied samples was varied from 0.4 to 1 mg. The bulk magnetic susceptibility (χ_v) was $1.2—3.6 \cdot 10^{-5}$, whereas the starting AA was diamagnetic with a susceptibility of $-0.68 \cdot 10^{-6}$.

The results suggest that the film precipitated on the cathode has a polyconjugated structure, which provides its high conductivity and the exchange interaction of spins of the paramagnetic centers.

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