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DC Discharge Plasma Polymerization of 1-Naphthylamine

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Naphthalene and their derivatives are promising blocks for building high-quality conducting polymers due to the extended p-electron systems in their molecules. 1-naphthylamine is a promising material for organic luminescent devices, and plasma polymerization is of undoubted interest in this regard, since it allows for the synthesis of polymers in the form of thin films and coatings. In this work thin polymer films from 1-naphthylamine have been obtained for the first time by polymerization at the cathode and anode in DC discharge. These films neither dissolved nor swelled in ethanol, acetone, heptane, at all, but the films obtained at the cathode were easy detached from the aluminum foil substrate with ethanol. Kinetics of the formation of polymer films obtained by the DC discharge at the cathode has been investigated, and it is shown that the growth rate of polymer films increases from 3 nm/s to 6 nm/s with the film thickness from 100 nm to 1 μm; then, the growth rate becomes constant. The morphology of polymer films synthesized under various conditions was examined by SEM and AFM. It was shown that the films have granular structure and a size of these granules is ~ 50 nm. The presence of micron-size aggregates composed from granules was also established. The elemental composition, chemical structure, and thermal stability of the polymer have been studied by pyrolysis chromatography, FTIR and UV spectroscopy, and thermogravimetry. By means of FTIR and UV spectroscopy the benzenoid-quinonoid moieties in polymer chain were found. Polymer synthesized by the DC discharge was investigated by ESR method. It is found that the spin concentration is equal to ~ 10^{19} spins/g, the line width at 300 K is equal to DB = 0.13 mT, and g factor is equal to 2.0020±0.0002. The data obtained confirm the presence of aromatic free radicals localized near nitrogen atoms.
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Keywords
1-naphthylamine
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polymer structure