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Analysis of surface morphology of films based on polyimide

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Abstract

Polyimides with molecular imprints are sorbents of new generation and are highly resistant to chemical and physical influences. In this work, a method for the preparation of molecularly imprinted polymers based on polyimide Kapton is proposed. The starting material in the synthesis of polyimide is polyamic acid in *N,N'*-dimethylformamide. The polyamic acid is synthesized from 1,2,4,5-benzenetetra-carboxylic acid and 4,4'-diaminodiphenyl oxide. The imidization of polyamic acid leads to the formation of polyimide Kapton. There are two carboxyl groups and two amide groups in the structure of the constitutional repeating unit of the polyamic acid, which make it possible to obtain molecularly imprinted polymers for different templates (amino acids, fatty acids, caffeine, ...).

Using the density functional method (DFT-B3LYP) in the 6-31G(d,p) basis, computer calculations of the structures of the constitutional repeating unit of the polyamic acid, palmitic and oleic acids, complexes of fatty acid with two units of the polyamic acid and polyimide chains were carried out in the Gaussian 09 program. It is shown that the template molecule forms the hydrogen bonds with the constitutional repeating unit of the polyamic acid through the carboxyl group. During the imidization, the hydrogen bonds between the template and the constitutional repeating unit of the polyamic acid are broken. After imidization, template achieves a new condition, in which it interacts directly with polyimide chains. The template can be located between two chains and can increase the distance between them.

The obtained polymer sorbent is often subjected to a series of tests aimed at the characterization of its morphological and physicochemical properties. In the work by the method of scanning force microscopy changes of surface morphology of molecularly imprinted polymers and non-imprinted control polymer were studied. It is shown that the non-imprinted polymer film without the addition of template has a more uniform surface with a height difference of 2-3 nm and contains 73.7% of pores with the radius of up to 25 nm, and the introduction of molecules of the template increases the degree of heterogeneity of the surface. It is established that the extraction of molecules-templates of the obtained molecularly imprinted polymers is no deformation of the surface of the films. The height difference on the surface relief of the resulting molecularly imprinted polymer for palmitic acid is 6.18 nm.

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