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Formation of pH-responsive polymer composite membranes by plasma-induced graft polymerization method

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The structure and the transport properties of polymer composite membranes consisting of a porous substrate and a polymer layer obtained by plasma-induced graft polymerization of 2-methyl-5-vinylpyridine and acrylic acid were studied. As a porous substrate a poly(ethylene terephthalate) track-etched membrane with a thickness of 9.5 μm and a pore diameter of 200 nm (pore density $2 \cdot 10^8$ cm^{-2}) was used. The treatment of the membrane samples by air plasma was performed in a RF-discharge at the frequency of 13.56 MHz. Only one side of the membrane was subjected to the plasma treatment. The graft polymerization of 2-methyl-5-vinylpyridine was conducted from 10% water solution of monomer at the temperature of 70°C. The graft polymerization of acrylic acid was performed from gas phase. For this purpose membrane was placed over the 25% water solution of monomer with temperature of 75°C. It has shown that the presence of the polymer layer of poly(2-methyl-5-vinylpyridine) and poly(acrylic acid) on the surface of track-etched membrane results in creation of pH-responsive membranes - the water permeability of the formed composite membranes substantially depends on the solution pH. These changes are caused by convertible conformational transitions of macromolecules of a polymer layer obtained by plasma-induced graft polymerization from an expanded state "coil" into a compact one "globule" which is in turn caused by the degree of ionization of functional groups of this layer. Membranes with such properties can be used in biotechnology and medicine, for example, for bioseparation and biocatalysts immobilization. They also can be used for controllable drug delivery, in biosensor controls, for modeling processes of regulation in the cell, etc.

Keywords
polymer composite membranes
plasma-induced graft polymerization
pH-responsive membranes