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SYNTHESIS AND ANALYSIS OF NITROCELLULOSE MEMBRANE BASED ON LOCAL RAW MATERIALS.

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A R T I C L E I N F O.

Keywords: nanoporous ion exchange membrane, cellulose, synthesis, nitrocellulose, allylglycidin ether, methyl alcohol, acetone.

Ключевые слова: - нанопористая ионообменная мембрана, целлюлоза, синтез, нитроцеллюлоза, эфир аллилглицидина, метиловый спирт, ацетон.

Annotation

The aim of this study is to synthesize nitrocellulose from cellulose obtained from local raw materials and to create and study a new composition of nanoporous membrane based on it, which is currently used as a selective membrane for the separation of ions at the nano and micro level, which is one of the sources of alternative selective separation. To achieve this goal, a nanoporous ion exchange membrane was synthesized and studied. According to the results of IR-spectroscopic analysis, a method of membrane formation was proposed and synthesis information was presented. Its differential thermal analysis was analyzed.

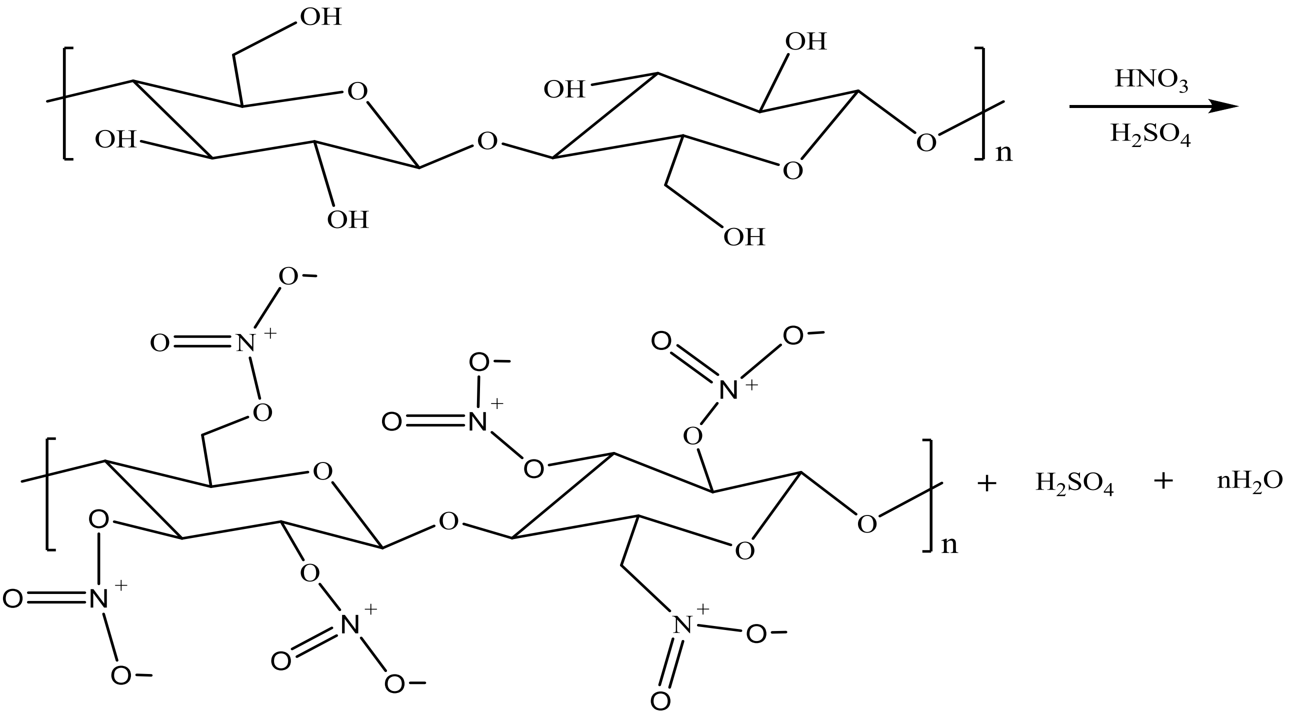
Аннотация: Целью данного исследования является синтез нитроцеллюлозы из целлюлозы, полученной из местного сырья, а также создание и изучение нового состава нанопористой мембраны на ее основе, которая в настоящее время является одним из альтернативных источников селективного разделения, селективной мембраны для разделение ионов на нано и микроуровне. Для достижения этой цели была синтезирована и исследована нанопористая ионообменная мембрана. По результатам ИК-спектроскопического анализа предложен метод формирования мембран и представлена информация о синтезе. Проанализирован его дифференциально термический анализ.

INTRODUCTION

Among the various separation membranes, the ion exchange membrane is one of the most advanced and is widely used in various industrial fields: electrodialysis, diffusion dialysis, electrolysis separator, separators of various batteries and solid polymer electrolytes, sensitive materials, membranes used in medical analysis, analytical chemistry used in one part and other fields. Membranes are thin polymer films of no more than 0.3 mm, which at the microscopic level usually have the form of a capillary, mesh or spongy frame, and their structure is an inseparable whole of individual elements. Pores in membranes are the spaces between the interior of the porous framework. Thus, unlike filters, membranes are typical representatives of two-phase colloidal systems of gas-solid type. [1] In our opinion, the difference between conventional and membrane filters is quite large. As we move from filters to membranes, we typically move to porous materials with smaller and smaller pores. Currently, membrane separation processes are used in many technological schemes, and their scope of application is expanding more and more. This is mainly due to technological simplicity, high efficiency, low material and energy consumption of membrane processes. For example, only membrane filtration techniques can effectively separate almost all ions and pathogenic microorganisms from large volumes of liquids and gases. Separation of substances by membranes is important in industry and human life. The fields and types of their application are as follows: microfiltration membranes, nanofiltration membranes, ultrafiltration membranes, reverse osmosis membranes, ion exchange membranes, liquid membranes, gas separation membranes, membranes for artificial kidneys, membranes for biological proteins and protein separation and detection, etc. In addition, new membranes are still being developed. [2] Membrane separation is a classic example of low energy intensity. For example, the field of membrane water desalination using simple reverse osmosis is about 10 times cheaper than water desalination by distillation. As can be seen from the information given below, the field of membranes is necessary and has a bright future. In this article, nanoporous membranes based on nirtocellulose were synthesized and their physical and chemical properties were analyzed [3]

EXPERIMENTAL PART II.

In the first stage of synthesis of nitrocellulose, 872 g of 65% nitric acid was slowly added to a 3-liter flask and the temperature was raised to 20-25 °C under ice water and kept at this state. Then, 1378 g of 98% sulfuric acid was slowly added for 1 hour with slow stirring. After adding all the ingredients, the container was closed and kept at room temperature for a day, shaking periodically every 4 hours. In the next step, the cotton cellulose cleaned and dried in distilled water was placed in a raw material container cooled at a temperature of 17-21 °C and mixed for 40 minutes. The resulting raw material was neutralized by washing it in distilled water. [4]Then it was placed in a 5% nitric acid solution and heated at 96 °C for 1 hour at a pressure of 4-5 atmospheres in an autoclave, and ready-to-use nitrocellulose was obtained by washing with disodium. The nitrocellulose synthesis process was carried out based on the following reaction sequence.



In the first step of membrane extraction, 5 g of nitrocellulose was taken and washed in 95% alcohol. Then it was kept in absolute alkohol for 14 hours. This nitrocellulose was dissolved in ether and stirred for 2 h.Alcohol was added to the resulting solution and stirred for 2.5 hours to form a colloid. [5] Acetone was added to transform the resulting colloid into a nanoporous membrane. The solution was dried at 22-26 °C with a relative humidity of 55-60% and a nanoporous membrane was obtained.

III. RESULTS AND THEIR DISCUSSION

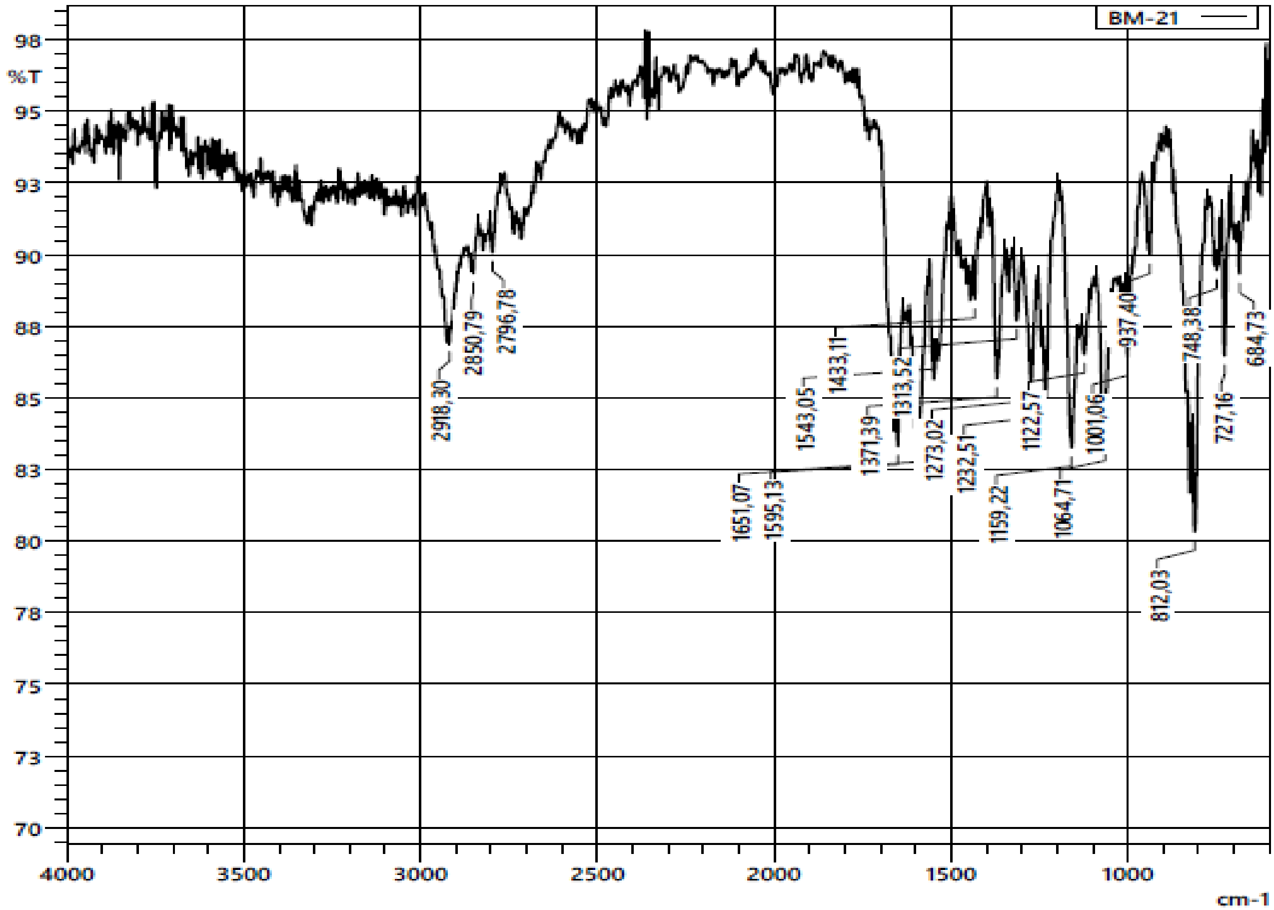


Figure 1. IR-spectrum of the membrane formed on the basis of nitrocellulose, allylglycid ether, ethyl alcohol and acetone.

In the values in Figure 1, the valence vibrations of $>C=O$ bonds in the area of 1651.07 cm^{-1}, valence vibrations of $-C-NO_2$ bonds in the region of 1543.05 cm^{-1}, valence vibrations of $-CH_3$ bonds in the 1371.39 cm^{-1} area, valence vibrations of $-C-O-C-$ bonds in the region of 1273.02 cm^{-1}, Correspondence to valence vibrations of $-C-OH$ bonds was observed in the region of 1122.57 cm^{-1}.

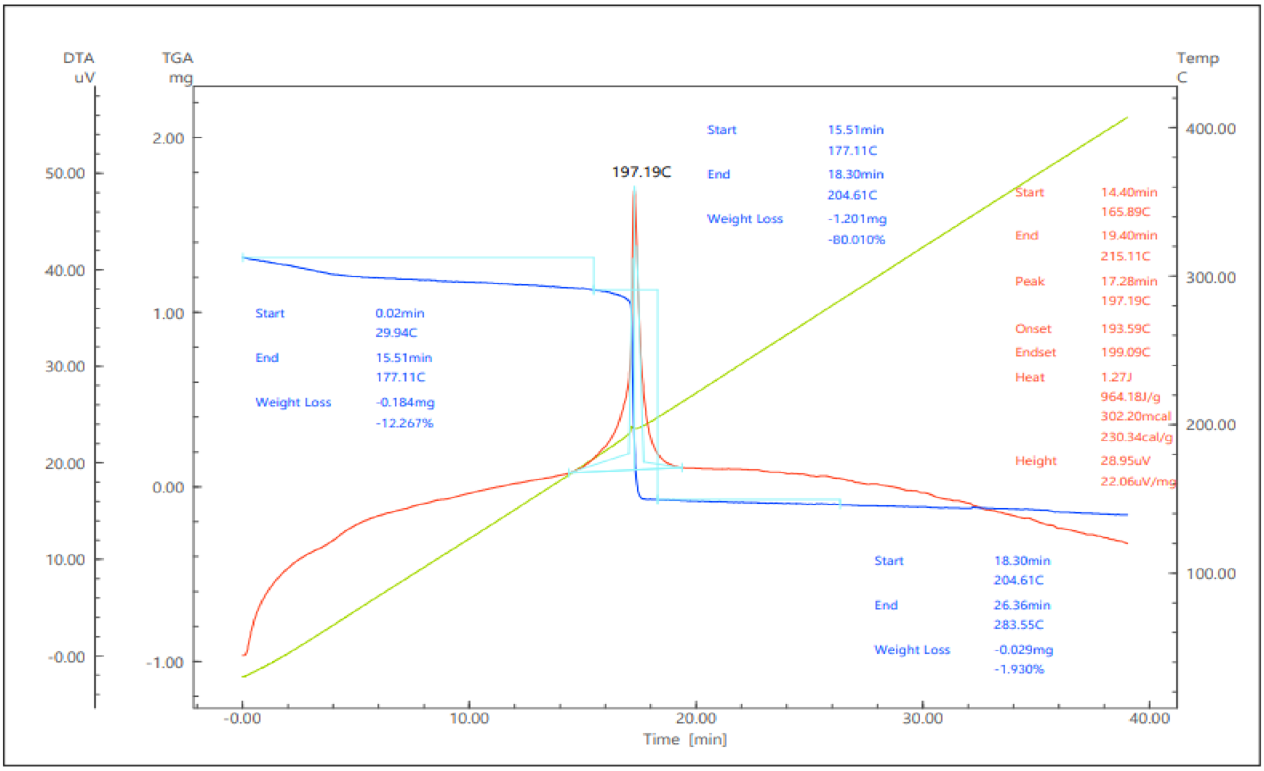


Figure 2. Thermal analysis of nitrocellulose membranes.

The results of the thermal analysis of the membrane obtained by copolymerization with allylglycid ether, ethyl alcohol and acetone cross-linked with nitrocellulose show that the mass loss occurs mainly in three stages (Fig. 2) The first stage involves the evaporation of acetone, ethyl alcohol and residual water at temperatures between 29.94 and 177.11°C, with a mass loss of -0.184 mg or -12.267%. It can be seen that the membrane retains water even at high temperatures. [2] The second mass loss of the polymer is observed in the temperature range from 177.11°C to 204.61°C. This indicates the fragmentation of these polymer chains, with a mass loss of -1.201 mg or -80.010%. The third mass loss is observed in the temperature range from 204.61 to 283.55°C. This indicates that the remaining functional groups decay, with a mass loss of -0.029 mg or -1.930%. [6]In general, the results of the thermogravimetric analysis revealed that the thermal performance of the membrane obtained by copolymerization with allyl glycide crosslinked with nitrocellulose, ethyl alcohol and acetone was much higher than the medium of GOST 19180-73, where ion exchange membranes can be transferred. [7]

CONCLUSION

In conclusion, it can be said that nanoporous nitrocellulose membranes are characterized by convenient and cheap synthesis processes and conditions. Synthesis of the resulting membrane was analyzed by infrared spectroscopy. When its thermal stability was analyzed, it was determined that it was in accordance with the standard for testing ion exchange membranes

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