SUPPORTED CuO-CERAMIC MEMBRANES FOR CATALYTIC APPLICATIONS

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Recently membrane technology has been widely used in many fields and one of the most interesting is using membranes in catalysis. Catalyst membrane reactor application allows carrying out the reactions at lower temperature and achieving higher selectivity due to the integration of two processes: chemical reaction and membrane separation.

Ceramic membranes with catalytic active layers are of particular interest. Copper oxide (II) itself and different oxide compositions based on CuO demonstrate considerable catalytic activity in many reactions, particularly in oxidation reactions. All well-known methods of copper oxide synthesis are not suitable for obtaining thin CuO layers on the surface of ceramic tubular substrates. Sol-gel technique is the most appropriate for synthesis of thin catalytic active layers because the regulation of the initial sol properties and parameters of the layer coating allows producing membrane with required phase structure and porous characteristics.

Aggregative stable copper oxide hydrosols were obtained by peptization of the copper (II) transient compounds which were synthesized by copper nitrate hydrolysis in sodium hydroxide presence. The results were well-reproducible, the concentration of the dispersed phase was not high (0.2% weight), but enough for thin layer obtaining. The mean hydrodynamic radius of the dispersed phase particles was determined by the dynamic light scattering, it was within the range of 100-120 nm. The estimation of the ζ-potential carried out using the electrophoresis showed that the particles were positively charged, the value of the ζ-potential was rather small and lied within a range from 32 to 38 mV.

In order to improve the aggregative stability hydroxyethylcellulose (HEC) was added to the hydrosols. The experiments conducted proved that the HEC addition allows protecting the particles against the coagulation in the presence of electrolytes. It should be mentioned that HEC acts not only as a stabilizer but it plays a role of the plasticizing agent.

Membranes with thin layers of CuO at the inner and exterior surfaces of supports were obtained by slip-coating and dip-coating. All the supports were pretreated by Na-carboxymetylcellulose in order to produce negative charge at the support surface. Contact time was of 2 minutes, pH value and HEC concentration were of 6.8 and 0.2% wt., respectively. After the coating membranes were dried at the room temperature for 2 hours, and then heated at 135ºC overnight and calcined

for 2 hours at 750ºC°. The prepared membranes were characterized by SEM, the cross-section images are presented in Figure 1

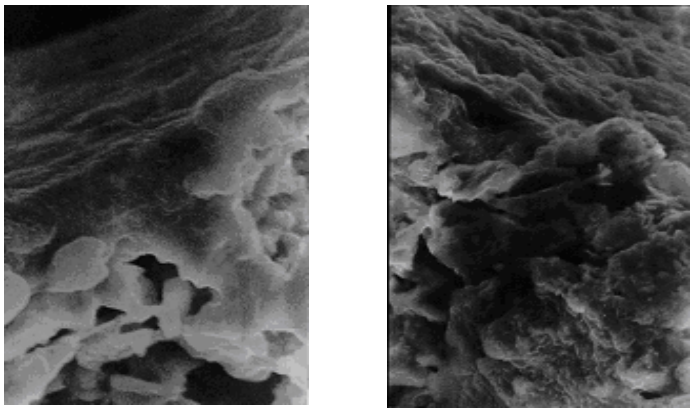

Fig.1. SEM images of cross-section of the membranes with 2 layers of CuO: the membranes with layers prepared from non-stabilized (at the left side) and stabilized CuO hydrosols (at the right side).

All the membranes with CuO layers exhibited the catalytic activity in the liquid-phase phenol oxidation in the water solutions. Phenol oxidation was carried out at 97-99ºC. The air was used as oxidative agent. Further development of such catalytic active membranes clears the way to the effective purification of waste water from many organic pollutants.