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Physicochemical Properties of Mesoporous Organo-Silica Xerogels Fabricated through Organo Catalyst

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Abstract: The physicochemical properties of organo-silica xerogels derived from organo catalyst were pervasively investigated, including the effect of one-step catalyst (citric acid) and two-step catalyst (acid-base), and also to observe the effect of sol pH of organo-silica xerogel toward the structure and deconvolution characteristic. The organo-silica xerogels were characterized by FTIR, TGA and nitrogen sorption to obtain the physicochemical properties. The silica sol–gel method was applied to processed materials by employing TEOS (tetraethyl orthosilicate) as the main precursor. The final molar ratio of organo-silica was 1:38:x:y:5 (TEOS:ethanol: citric acid: NH_3:H_2O) where x is citric acid concentration (0.1–10 $\times$ 10^{-2} M) and y is ammonia concentration (0 to 3 $\times$ 10^{-3} M). FTIR spectra shows that the one-step catalyst xerogel using citric acid was handing over the higher Si-O-Si concentration as well as Si-C bonding than the dual catalyst xerogels with the presence of a base catalyst. The results exhibited that the highest relative area ratio of silanol/siloxane were 0.2972 and 0.1262 for organo catalyst loading at pH 6 and 6.5 of organo-silica sols, respectively. On the other hand, the organo-silica matrices in this work showed high surface area 546 m^2 g^{-1} pH 6.5 (0.07 $\times$ 10^{-2} N citric acid) with pore size ~2.9 nm. It is concluded that the xerogels have mesoporous structures, which are effective for further application to separate NaCl in water desalination.

Keywords: organo-silica xerogel; mesoporous material; one-step catalyst; two-step catalyst

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1. Introduction

Materials of mesoporous structure are synthesized by sol–gel process, which is a versatile approach to form functional materials for membranes, sensors, catalytic and optical applications. In the past few years, fabrication and application of thin film as a membrane for separation have become a concern to development, especially for desalination. There are two types of materials commonly used such as organic and inorganic. Organic-based materials such as polymers are widely utilized for water purification, and inorganic for gas separation. However, inorganic-based materials are offering more advantages, i.e., robustness, high molecular sieving, resistance to high temperature and long lifespan. Silica is one inorganic based material that has good chemical stability and is affordable to