Optimization of Experimental Conditions Based on Taguchi Robust Design for the Synthesis of Nano-Sized NaA Zeolite Particles

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This investigation was aimed at preparing NaA nanozeolite without any organic additives, and searching the optimum preparing conditions by employing Taguchi robust design method. Taguchi robust design method with L$_9$ orthogonal array was implemented with three levels of parameters to optimize experimental conditions by the analysis of variances (ANOVA)[1]. Zeolites are crystalline, aluminosilicate molecular sieves, which can be synthesized with a wide range of pore sizes and topologies and are used in applications, such as catalysis, chemical separations, and adsorbents. Recently there has been a great deal of interest in the synthesis of nanocrystalline zeolites, that is zeolites with discrete uniform crystals with dimensions of less than 100 nm, and their unique properties relative to conventional micrometer-sized zeolite crystals [2]. The optimization of the synthesis procedures for nanosized crystals has been gaining a significant attention as a new application continues to emerge. Due to a larger accessible surface area and to facilitate the mass transfer process of nanocrystals, these are useful in establishing zeolite application such as catalysis, sensing, medical diagnosing and low-dielectric insulting [3]. In order to produce NaA nanosized crystals with a narrow crystal-size distribution, colloidal zeolites were crystallized from clear solution with high alkalinity. The effects of SiO$_2$/Al$_2$O$_3$ and Na$_2$O/SiO$_2$ ratios, crystallization time, and temperature in the initial synthetic mixture on the crystallization of NaA zeolite nanoparticles under atmospheric pressure were studied. Applying the Taguchi method significantly reduced the time and cost for optimization [4]. The obtained products were characterized by scanning electron microscopy, X-ray diffraction and FT-IR spectroscopy. As a result of the Taguchi analysis Na$_2$O/SiO$_2$ followed by temperature was the most influencing parameters for the synthesis of nanosized NaA crystals.

REFERENCES