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Sonohydrothermal Synthesis of Zeolite A

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PURPOSE OF THE ABSTRACT

Since their discovery in 1756, zeolites have attracted a lot of attention and are still at the heart of numerous studies due to their unique structural properties and their applications in many fields including catalysis and separation chemistry [1]. The development of hydrothermal synthesis has allowed the access to a large panel of zeolites offering a wide array of morphologies with specific three-dimensional structures. In the same way, recent studies have highlighted the importance of ultrasonic treatment during the preparation of these materials and its influence on the transformation kinetics of the crystalline phases during thermal treatment [2].

In the present study, the influence of ultrasound and hydrothermal conditions on the synthesis of LTA zeolite was thus investigated and, for the first time, the simultaneous coupling of ultrasound and hydrothermal conditions was considered for the synthesis of this type of material. This work was carried out using a sonohydrothermal reactor allowing the application of an ultrasonic irradiation at 20 kHz within an autoclave type reactor heated up to 200 °C under autogenous pressure [3]. Since this synthesis procedure involves both the precipitation of an aluminosilicate gel in a basic medium and its transformation under hydrothermal conditions between 100 and 150 °C, the action of ultrasound during the precipitation stage but also during the crystallization process of the material has been investigated. In order to evaluate the influence of the operating conditions on the structural properties as well as on the crystallization kinetics of the various phases in presence, the whole synthesized products was characterized by several analytical techniques like X-ray diffraction (DRX), gas adsorption (BET) and electron microscopy (MET/MEB). All obtained results pointed out the dramatic influence of the sonohydrothermal conditions on the product morphology as well as on the transformation kinetics of the LTA zeolite into sodalite observable after only 4 hours of treatment at 100 °C, as shown in Figure 1, whereas treatment times of nearly 22 hours are required without ultrasonic irradiation in classical hydrothermal conditions under the same conditions [4].

FIGURES

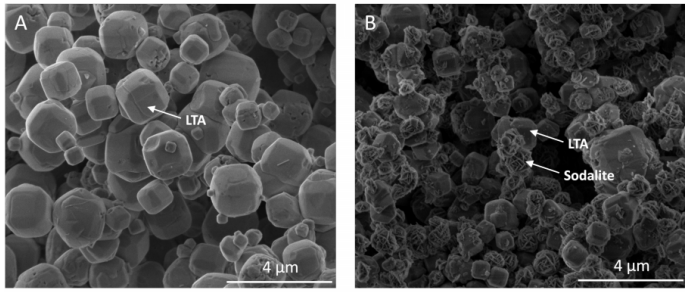

FIGURE 1

Figure 1

SEM images of the samples obtained after 4 hours of hydrothermal treatment at 100 °C (A) and after a 4h sonohydrothermal treatment at 100 °C under 20 kHz ultrasonic irradiation (B).

FIGURE 2

KEYWORDS

sonohydrothermal | zeolite | synthesis | ultrasound

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