

# Nanocomposites and nanomaterials

## Synthesis and properties of micromesoporous materials based on zeolite BEA and mesoporous cellular foams

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Mesoporous zeolites exhibit an increased accessibility to reagents' molecules, which leads to increased catalytic activity and/or productivity in the reactions which occur in zeolites with diffusive or steric limitations or do not occur at all. The purpose of the work is to clarify the features of template synthesis of micromesoporous materials from primary products of zeolite-formation (sols-precursors) BEA and the mesoporous cellular foams (MCF), determine their structure, sorption properties and acidity.

The obtained samples haven't zeolite single phase. They have spongy structure typical for mesoporous cellular foams. The obtained samples are predominantly mesoporous materials ( $V_{\text{meso}} \sim 1.1 \text{ cm}^3/\text{g}$ ,  $S_{\text{meso}} = 150 - 330 \text{ m}^2/\text{g}$ ), which also include the micropores which volume is lower ( $0.11-0.15 \text{ cm}^3/\text{g}$ ) in comparison with BEA zeolite ( $0.23 \text{ cm}^3/\text{g}$ ), which is consistent with a decrease in the degree of crystallinity of zeolite phase by XRD data. The obtained samples are characterized with slightly higher specific surface area (up to  $690 \text{ m}^2/\text{g}$ ) than MCF ( $\sim 500 \text{ m}^2/\text{g}$ ) due to the appearance of inclusions of BEA zeolite phase into the walls of cellular foams and accordingly higher micropore volume.

The sample with higher degree of zeolitization (about 0.4) contains acid sites of average strength, besides it has strong acid sites (the total concentration of acid sites is  $0.37 \text{ mmol/g}$ ). Low crystalline sample (degree of zeolitization  $\sim 0.08$ ) contains predominantly acid sites of average strength (the total concentration is  $0.17 \text{ mmol/g}$ ). All samples possess both Brønsted and Lewis acid sites.

Comparison of the obtained results indicates significant deviations from additivity for characteristics of synthesized samples. Thus, at relatively uniform increasing of the degree of crystallinity the obtained values of acidity (concentration of acid sites) are significantly higher than the values obtained under condition that only zeolite phase contains acid sites: for low-crystalline sample this deviation is the highest – difference of 4 times. We can assume that the presence of zeolite precursors which probably have a high surface energy, causes the growth of the concentration of acid sites which doesn't correspond the degree of crystallinity.