Abstract

This bachelor thesis focusses on the synthesis, post-synthesis modification, and comprehensive characterization of two series of zeolites based on IWW and ITH topologies. The investigated zeolite structures were chosen because their frameworks contain d4r units preferentially occupied by Ge atoms, which can be substituted for various catalytically active metal sites such as Al, Ti, and Sn by post-synthesis degermanation/metallation.

To study the influence of the chemical composition of the parent germanosilicate on the concentration and accessibility of the incorporated Al-, Ti- and Sn-associated acid sites, IWW and ITH were hydrothermally synthesized with different amounts of germanium in the reaction mixture (Si/Ge = 4 – 10 for IWW and Si/Ge = 10 – 30 for ITH) and used for post-synthesis Ge- for-metal substitution.

X-ray diffraction (XRD) was used to verify the structure of the synthesized zeolites; chemical analysis identified their elemental composition; nitrogen physisorption was used to determine their textural characteristics (e.g., micropore volume, total pore volume pore, and external surface area), while scanning electron microscopy (SEM) was applied to visualize the shape and size of the zeolite particles. The coordination state of the incorporated Ti and Sn sites was studied using UV-vis spectroscopy, while FTIR spectroscopy of adsorbed base probe molecules (pyridine, 2,6-ditertbutylpyridine, d_3-acetonitrile) provided information on the nature and concentration of acid sites that are accessible to base molecules of different sizes. The results reveal that variation in the Si/Ge ratio allows one to modify the size and shape of IWW crystals as well as the concentration of acid sites incorporated into IWW and ITH zeolites.