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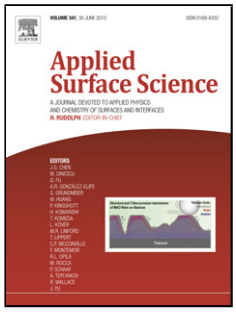


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Author: Xiaoyu Wang Kunping Wang Chris A. Plackowski Anh V. Nguyen

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# Sulfuric acid dissolution of 4A and Na-Y synthetic zeolites and effects on Na-Y surface and particle properties

*Xiaoyu Wang*[*], *Kunping Wang*[**], *Chris A. Plackowski*, *Anh V. Nguyen*

School of Chemical Engineering, The University of Queensland, Brisbane, QLD 4072, Australia

## Abstract

Sodium rich synthetic zeolites 4A and Na-Y have different silicon-to-aluminium (Si/Al) ratios and are widely used as molecular sieves, catalysts and adsorbents. This study investigates the changes in 4A and Na-Y synthetic zeolites treated by $H_2SO_4$ at room temperature. Both zeolite types are examined before and after treatment by following the dissolution and re-crystallisation processes, and Na-Y by X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and particle size analysis. Na-Y zeolite (high Si/Al ratio) has stronger acid-resistivity than 4A zeolite (low Si/Al ratio) and can be treated with $H_2SO_4$ up to 5 M without complete dissolution, whereas 4A zeolite is completely dissolved by 0.5 M acid. For both zeolites, the treatment generates dissolution (of both Si and Al) of first order fast kinetics, followed by re-crystallization. XRD studies of Na-Y zeolite indicate that acid treatment leads to structural changes where cations are removed and as dissolution progresses de-alumination takes place, thereby altering the main tetrahedral structure. XPS analysis shows the Si/Al atomic ratio for Na-Y zeolite increases from 2.94 at 0 M to 8.18 at 0.1 M, and a significant binding energy (BE) shift of Si and O occurs even at a high Si/Al ratio. The acid treatment increases the surface intermediate electronegativity of Na-Y zeolite, and the BE of each main structural element changes in the same way as the electronegativity ratio (element electronegativity to total surface electronegativity) as the acid concentration increases. Particle size analysis indicates that a recrystallization process occurs during acid treatment, as shown by a shift of the coarse particle distribution peak size to progressively smaller sizes with increasing acid concentration.

*Keywords:* synthetic zeolite, acid treatment, recrystallization, binding energy, electronegativity

*Corresponding author, email: xiaoyu.wang@uq.edu.au, Tel: +61 7 33466465
**Permanent Address: Faculty of Urban Construction and Environmental Engineering, Chongqing University, Chongqing 400045, PR China