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論文要約

ゼオライトの低環境負荷型合成手法の開発と応用に関する研究

Study on development of environmentally-benign method for zeolite synthesis

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This thesis focuses on reducing the environmental impacts during zeolite preparation. It explores novel and improved methods for synthesizing zeolites with lower environmental impacts. The thesis is divided into six chapters.

Chapter 1 introduces the basic background of zeolites, especially TUN and CHA type zeolites, their synthesis methods, and the environmental impacts in their synthesis processes. It sets the research objectives and significance of this thesis.

Chapter 2 discusses the development of a rapid synthesis method for TUN-type zeolites using MWW-type zeolites as a starting material, significantly shortening the synthesis time and reducing the use of organic structure-directing agents (OSDAs). This chapter demonstrates the potential for environmental impact reduction in TUN-type zeolite synthesis.

Chapter 3 extends the rapid synthesis approach to TUN-type zeolites using MFI-type zeolites as raw materials, achieving further reductions in synthesis time and particle size. This method enhances the nucleation by utilizing the composite building units (CBUs) from MFI-type zeolites, contributing valuable insights into zeolite nucleation and growth and catalyst lifetime improvement.

Chapter 4 explores a low environmental impact synthesis method for CHA-type zeolites using rice husk charcoal (RHC) as a silica source, avoiding using OSDAs and achieving high yields and excellent adsorption removal capacities for Cs and Sr cations. This approach highlights the potential of utilizing agricultural waste in zeolite synthesis.

Chapter 5 develops a "green" synthesis method for CHA-type zeolites that minimizes the indirect use of OSDAs and amorphous silica from the seed, yielding zeolites with comparable properties. The method also demonstrates the feasibility of synthesizing subsequent generations of CHA-type zeolites, offering a sustainable approach to zeolite preparation.

Chapter 6 summarizes the findings across all chapters, emphasizing its contribution to developing environmentally-benign zeolite synthesis methods that do not compromise on the performance of the resulting materials.