OBJECTIVES

There are three main parts of this research: 1) nanostructured materials synthesis 2) nanostructured materials characterization and 3) environmental applications. Therefore, the objectives of this study are:

1. To synthesize and characterize SUZ-4 zeolite via sol-gel method

2. To synthesize and characterize SiO_2-TiO_2 and SiO_2-Al_2O_3 nanocomposite materials by flame aerosol technique

3. To study elemental mercury (Hg°) captured by various nanostructured sorbents in a differential bed reactor (DBR) with and without in-situ ultraviolet (UV) irradiation

4. To study photocatalytic degradation of methyl orange on some nanostructured materials

Scope of the Investigation

1. Part I: Nanostructured Materials Synthesis

1.1 SUZ-4 zeolite

In this work SUZ-4 zeolite was synthesized by hydrothermal sol-gel method at different gel composition (e.g. SiO_2/Al_2O_3, TEA_2O/Al_2O_3, H_2O/Al_2O_3, K_2O/Al_2O_3), crystallization temperature and time under autogenous pressure. SUZ-4 zeolite membrane was tried to initial produce from suitable condition.

1.2 Nanocomposite materials

Two different systems of SiO_2-based multicomposite, SiO_2-TiO_2 and SiO_2-Al_2O_3 were synthesized at different precursor molar ratio. Furthermore, at a given precursor molar ratio, quench ring position related to the flame conditions was varied to synthesize in different particle sizes, specific surface areas and morphology.

2. Part II: Nanostructured Materials Characterization

Nanostructured materials were characterized using X-ray powder diffraction (XRD), BET N_2-adsorption, Scanning electron microscope (SEM), Transmission electron microscope (TEM), Fourier transform infrared spectroscopy (FTIR), UV-vis spectroscopy and dynamic light scattering from Zeta potential measurement.

3. Part III: Environmental Applications

The elemental mercury captured by various nanostructured sorbents was studied in a differential bed reactor (DBR) at a room temperature with and without in-situ ultraviolet (UV) irradiation. The scope of this study are (1) to develop a robust method for determination of the initial rate of Hg capture by different sorbents (e.g., commercially available iron oxides in different crystalline phase structures, TiO_2, TiO_2-PILC, synthesized SUZ-4 zeolite and magnetite), (2) to establish the relation between the physical characteristics of sorbents and their capture capacities, and (3) to determine the binding characteristics of mercury with the sorbent. Furthermore, photocatalytic degradation of methyl orange dye was investigated for different nanostructured materials.

Benefits of Study

The results obtained from this research help both of understanding nanostructured materials formation and their utilizations in chemical engineering and environmental engineering areas that are:

1. Novel technique for nanocomposite materials having different morphology and crystal phases was studied.

2. Preparation of new SUZ-4 zeolite membrane has been primarily produced.

3. More understanding of initial rate of mercury capture and mechanisms for gas-phase reaction system was investigated.

4. New whole knowledge for colloidal dispersion behavior of different nanostructured materials brings and extends to the liquid system application for related industries.