Abstract

There are 4 chapters in this thesis. Chapter 1 provides background material for the whole thesis. Chapter 2 describes the development of a multiframework doping method to enhance catalytic activity of porous transition metal oxides, particularly, manganese oxide octahedral molecular sieves (OMS-2). Chapter 3 discusses the use of ultraviolet radiation to make transition metal oxide materials. Chapter 4 concerns the scale up of the UV radiation method by extending it to a continuous flow method. ^ Manganese oxide octahedral molecular sieve (OMS-2) materials possess vast properties that are tailorable for different applications such as separation, energy storage, catalysis, and data storage. Chapter 2 discusses multiple framework substitutions developed to control particle size and morphology of these materials. Self-assembled multi-doped OMS-2 hollow microspheres with ultrafine particles in the size range of 4-6 nm, and with very high surface area of 380 m^2/g have been synthesized. These multi-doped OMS-2 materials were used in catalytic oxidation of diphenylmethanol. Catalytic performance of the synthesized multi-doped OMS-2 materials was found to be superior than their previously reported counterparts. ^ Metal oxide nanomaterials are currently prepared by thermal strategies such calcination, reflux, hydrothermal methods among others. In most of these methods, template and structure directing agent are invariably used to intergrate one-dimensional (ID) metal oxide nanomaterials into into three-dimensional (3D) superstructures. A rapid and non-thermal approach based on ultra violet (UV) light for synthesizing gamma manganese oxide (γ-MnO_2), cerium oxide (CeO_2), and cobalt oxide hydroxide (CoOOH) materials was designed and optimized and is reported in Chapter 3. With this method, 3D microspheres and microflowers were prepared without template. Hollow core-porous shell γ-MnO_2 microspheres, CoOOH microflowers, and solid CeO_2 microspheres with surface areas of 179, 141 and 1 m^2/g, respectively, were successfully fabricated. In Chapter 4, this UV light method was further extended to synthesis of γ-MnO_2, OMS-2, and CeO_2 materials under continuous flow conditions. The morphology of γ-Mn02, OMS-2, and CeO_2 materials was found to be influenced profoundly by flow rate, type of acid, and UV intensity.