CHAPTER VII
CONCLUSIONS AND RECOMMENDATIONS

The chemistry of the starting inorganic precursor is an essential tool in the search for rational synthesis designs. This work provides an overview of the chemistry associated with the sol-gel process of ceramic oxides by the metal-organic route and has attempted to outline the basic philosophy behind the development of sol-gel precursors. There is now ample evidence suggesting that complex formation is desirable and does occur in sol-gel precursors. Herein, the chelated metal alkoxides, atrane and ethylene glycolate complexes, were successfully synthesized by the oxide one-pot synthesis process in very high yields. This anodic dissolution can provide an easy and straightforward way to scale up the synthesis of many metal alkoxides. The chelating nature of the glycol and triisopropanolamine achieved by the central atoms in the final products appears to be the main factor for their hydrolytic stability to retard the hydrolysis and condensation reaction rates to obtain homogeneous gels rather than precipitates. Atrane and ethylene glycolate complexes can be used as metal alkoxide precursors for preparing high surface area porous oxide materials via the sol-gel process.

Moreover, it is evident that the procedure is also applicable to obtain gels and porous materials. In most cases, these high surface area materials confers on their inherent thermodynamic metastability. Control of their preparative chemistry essentially is kinetic. By considering on kinetic grounds, it is perfectly possible to select a hydrolysis retarding agent adequate to harmonize the hydrolytic processes involving metals of different basicities. Beyond all doubt, the versatility of the atrane and ethylene glycolate complexes open new prospects for improving the preparative chemistry and, therefore, performances of porous oxide materials. Additionally, the operation variables, viz. pH, hydrolysis ratio and temperature, are to impact on the gelation time and the properties of the gels. Independence of the starting compositional complexity, the resultant materials are chemically homogeneous. In most cases, the final porous oxide materials obtained are thermally stable and show unimodal porosity, as well as homogeneous microstructure and texture.

The present work does not only give an important information about the reaction of atrane and metal ethylene glycolate complexes, but also is a useful guideline to extend the efforts to synthesize other chelated metal alkoxide precursors for preparing other porous oxide materials in the future. Moreover, the obtained porous oxides were expected to be useful materials for a wide range of applications, such as catalysis, membrane separation processes, composites, coating, fiber and electronic and optic fields, etc. In particular, the development of ceramics that possess higher purity, strength, and homogeneity is of major industrial interest. Due to their viscous properties, the sol-gel technology is also easily used in the development of thin films from such techniques as dip-coating, spraying, and spin coating. Additionally, oxide-one pot synthesis of other alkoxide ligands should be further investigated so as to extend the structural aspects for preparing high surface area oxide materials over a wide variety of applications. Furthermore, mixed-oxide or multicomponent porous materials are one interesting aspect to improve the performance and stability of the surface area at high temperature and lead to commercial products.