Development of a Novel, Hybrid Compound as a Single-Source Precursor for Nanocrystalline Manganese Oxide and Sulfide

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Manganese oxides (MnxOy) and manganese sulfide (MnS) have become significant materials for extensive research in different fields. Most of their synthesis methods have drawbacks, such as being time-intensive and requiring sample pretreatment. In this study, a novel, hybrid organic-inorganic compound of cyclohexylammonium hexaisothiocyanatomanganate(II),was synthesized and characterized for its use as a single-source precursor for the preparation of nanocrystalline, mesoporous, high surface area Mn2O3 and MnS via thermolysis, under air and inert gas atmosphere. A four-step energy-saving synthesis procedure, based on metathesis and ligand addition chemical reactions at room-temperature, was followed to obtain the target compound . The Fourier transform infrared (FTIR) analysis and X-ray powder diffraction (XRD) confirmed the formation of the desired new hybrid organic-inorganic compound. The thermal gravimetric analysis (TGA) indicated that the new compound had the molecular formula of (C6H11NH3)4[Mn (NCS)6]0.2H2O and showed that MnS and Mn metal were formed at 550°C under inert gas atmosphere with ~11.0 wt% remaining after the completion of thermal decomposition. On the other hand, manganese(III) oxide, Mn2O3, was formed under air at 800°C with remaining weight percentage of ~12.0%. In conclusion, this method of preparing the new compound of cyclohexylammonium hexaisothiocyanatomanganate(II) was proven to be a simple, easy, energy-saving route. Obtaining manganese oxide and sulfide, with mesoporous, high surface area characters, has the potential to be used for various applications such as in batteries, solar cells, sensors, optical mass memories, catalysis, and water purification.

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