Nanomaterials via Single-Source Precursors
Synthesis, Processing and Applications
2022, Pages 531-562

Chapter 16 - Coinage metal chalcogenides via single-source precursors

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Abstract

The present chapter is focused on the important developments of the last two decades in the synthesis of nanosized coinage metal chalcogenides via single-source precursor (SSP) routes and their applications. Copper (Cu), silver (Ag), and gold (Au) (commonly called coinage metals) form a variety of complexes with chalcogen (S/Se/Te) ligands, serving as SSPs for the fabrication of binary and ternary phases of sulfides, selenides, and tellurides (S, Se, Te). The CuS, chalcocite (Cu_2S), CuS_2, digenite ($Cu_{1.8}S$ or Cu_9S_5), djurleite ($Cu_{1.94}S$), CuSe, $Cu_{29}S_{16}$, $Cu_{2-x}Se$, Cu_3Se_2, Cu_7Se_4, Cu_9Se_5, Cu_2Se, $Cu_{1.8}Se$, $Cu_6Se_{4.5}$, $Cu_{2.8}Te_2$, $Cu_{2-x}Te$, CuTe, acathinite (α-Ag_2S), argentite (β-Ag_2S), α-Ag_2Se, β-Ag_2Se, Ag_7Te_4, and $AuTe_2$ are the examples of binary phases whereas examples of ternary phases are $CuInS_2$, Cu_4SnS_4, $CuInSe_2$, $AgInS_2$, $AgIn_5S_8$, $AgInSe_2$, $CuGaS_2$, $AgGaS_2$, and $AgIn_5S_8$. The coinage metal tellurides synthesized via single-source precursor route are fewer in number than sulfides and selenides. Thus, the number of reports on Cu/Ag/Au sulfide and selenide nanophases significantly outnumber those of the metal tellurides. The SSP route is much less often reported for gold chalcogenides and their nanophases. The protocols developed for the synthesis of single-source precursors of coinage metals for preparing their chalcogenides are outlined here. Salient structural aspects of such precursors have also been given a place. The methods (i.e., thermal decomposition and chemical vapor deposition, etc.) used to convert single-source precursors into nanosized metal chalcogenides are emphasized. The effect of reaction conditions and structure/nature of precursor on the morphology or composition of resulting nanomaterial is focused. The important applications of the coinage metal chalcogenides prepared via SSP routes are the final topic in the chapter.