Synthesis and sintering of sulfide-based optical ceramics

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Due to their favorable optical performance and mechanical properties, zinc sulfide (ZnS) and calcium lanthanum sulfide ($CaLa_2S_4$) have been studied as promising candidates for infrared optical ceramics. In this work, ZnS and $CaLa_2S_4$ powders were first synthesized by using a wet chemistry method to form a ceramic powder and then were sintered at different temperatures by using a hot-pressure and a field-assisted sintering technique to process bulk ceramics. Through a colloidal processing method, ZnS powder with homogeneous morphology and large surface area was synthesized and $CaLa_2S_4$ precursor was synthesized by using a facile ethanol-based single-source precursor route. The effects of varying different processing parameters, in both the powder synthesis and consolidation stages, were studied to develop a procedure for fabricating sulfide-based optical ceramics. Sintering behaviors and grain growth kinetics were studied through densification curves and microstructural characterizations, from which the diffusion mechanisms to control grain growth were analyzed. The phase compositions and morphologies of the synthesized powder and sintered ceramics were studied by using X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM), respectively, in addition to the surface area and pore size analyses and optical characterization.