

Design of multifunctional Materials: Chalcogenides and chalcopyrites

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There is a strong need for developing multifunctional materials to reduce the cost of applied material without compromising the performance of the detectors, devices and sensors. The materials design, processing, growth and fabrication of bulk and nanocrystals and fabrication into devices and sensors involve huge cost and resources including multidisciplinary team of experts. Because of this reason prediction of multifunctionality of materials before design and development should be evaluated. Chalcogenides and chalcopyrites are very exciting class of materials for developing multifunctionality. Materials such as Gallium selenide GaSe and zinc selenide ZnSe have been proven to be excellent example. GaSe is a layered material and very difficult to grow in large crystal. However, its ternary and quaternary analogs such as thallium gallium selenide TlGaSe_2 , thallium gallium selenide sulfide $\text{TlGaSe}_{2-x}\text{S}_x$, thallium arsenic selenide Tl_3AsSe_3 , silver gallium selenide $\text{AgGaGe}_3\text{Se}_8$, $\text{AgGaGe}_5\text{Se}_{12}$ and several other have shown great promise for multifunctionality. Several of these materials have shown good efficiency for frequency conversion (nonlinear optical NLO), electro-optic modulation, and acousto-optic tunable filters and imagers suitable for the visible, near-infrared wavelength, mid wave infrared (MWIR), longwave wave infrared (LWIR) and even up to Tera hertz wavelength (THW) regions. In addition, this class of materials have demonstrated low absorption coefficient and power handling capability in the systems. Also, these crystals do not require post growth annealing, show very large transparency range and fabricability.

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