Volatile Crystalline Semiconductor Core Fibers

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The flux assisted molten core method first realized GaAs:Sn semiconductor core fibers[1], has now successfully drawn fiber containing ZnSe. This break with conventional wisdom which stated, due to the volatility and decomposition at or above these species respective melt temperatures, under ambient conditions, renders the molten core method an incompatible fabrication process. Through the use of a flux (Sn and Cu for GaAs and Cu_8GeSe_6 and MnSe for ZnSe) the melt temperature of the semiconductor was decreased to a point where the volatility was negligible and allowed for glass-clad, crystalline GaAs and ZnSe containing fibers to be drawn. A CO_2 laser annealing post processing method was utilized to segregate the flux and semiconductor phases, both laterally and longitudinally along the fiber. Lengths of up to 5mm of lateral segregation of the GaAs:Cu system has now been realized. Various analytical and microscopic characterization methods were used to confirm elemental distribution, phase formation, grain structure, and stress effects of the as drawn and laser annealed fibers. This work represents an approach to incorporating volatile and incongruently melting phases that are not compatible with the standard molten core method to realize new compositions that open the door to novel in-fiber optoelectronic, thermoelectric, and photonic devices.

[1] T. Zaengle *et al.*, "A Novel Route to Fibers with Incongruent and Volatile Crystalline Semiconductor Cores: GaAs," *ACS Photonics*, 2022, doi: 10.1021/acsphotonics.2c00008.