THIN FILM DEPOSITION OF $Ge_{33}As_{12}Se_{55}$ BY PULSED LASER DEPOSITION AND THERMAL EVAPORATION: COMPARISON OF PROPERTIES

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We have produced thin films of $Ge_{33}As_{12}Se_{55}$ using two deposition techniques, ultra-fast pulsed laser deposition (UFPLD) and thermal evaporation (TE) and investigated the effect on their properties. Due to their high nonlinearity, high refractive indices and transmittivity in the infra-red, chalcogenide glasses show great promise for photonics applications such as all optical switching and processing. $Ge_{33}As_{12}Se_{55}$ has proven to have high nonlinearity and large magneto-optic coefficient. For the aim of fabricating waveguides, we ablate bulk glass targets of commercially available AMTIR-1 ($Ge_{33}As_{12}Se_{55}$) by UFPLD, a unique method using 532nm ultra-short 17ps laser pulses at a high repetition rate (28MHz) to deposit high quality films without particulates (a common problem with conventional PLD). Films were also deposited by TE and the films compared.

Analysis of the composition of films deposited with each method showed that TE films had elevated Arsenic content at the expense of Germanium. When the substrates were heated to 190^{o}C during deposition, the TE films reverted to a composition more closely resembling the bulk target material. In contrast, the UFPLD films were stoichiometric, reproducing the composition of the target material. The optical properties and structure of these films have also been investigated, and considerable differences have been found in refractive indices, surface quality and in the effects of high temperatures on films pos-deposition

These findings have important implications for the fabrication of photonic waveguides. Change in stoichiometry affects the refractive index and absorption, and therefore affects the operation parameters of waveguide devices. However, this change in composition with different deposition conditions presents an opportunity for tuning desired optical parameters.