2677

Through Thick and Thin: Recent Developments with Chalcogenide Films

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Interest in chalcogenide materials has, over the past few years, increased significantly as glasses, crystals and alloys find new life in a wide range of devices. Many of these applications require chalcogenide films, from nanometer to millimeter thicknesses, to exploit the functionality of this family of materials. Our own research has concentrated on amorphous and crystalline chalcogenides formed with gallium and/or germanium sulphides. These glass forming groups offer an alternative to the better known arsenic-based glasses, providing lower toxicity, higher melting temperatures as well as the ability to be modified with a wide range of dopants including rare earths, transition and precious metals (e.g. silver and platinum). Crucially, we have synthesized both gallium and germanium-based glasses in an open flowing atmosphere. In doing so, the need for sealed ampoules and elemental compounding during glass synthesis is unnecessary, high purity large scale melts can thus be prepared. In particular the prominent SH^- absorption band around 4 microns, a common feature in chalcogenide IR glasses, has been effectively eliminated from our gallium based glasses due to the open melting procedure.

To achieve the desired thick and thin chalcogenide films, we currently exploit three deposition methods; chemical vapor deposition, inverted hot dip spin coating and pulsed laser deposition. These techniques allow for the deposition of films having thickness from several nanometers to hundreds of microns. The driving force behind our work has been the realization of planar optical waveguides for optical integrated circuits. To date, high quality films (10 – 500 microns) from the gallium-based glasses are routinely achieved with excellent uniformity and interfacial features. Single mode channel waveguide lasers with device attenuation < 0.5 dB cm^{-1} have been realized via direct laser writing on the surface of a gallium-based sample. In addition, buried channel waveguides as well as permanent and short-lived "dots" have also been achieved through direct laser writing. Demonstrations of the aforementioned photomodifying capabilities of our glass suggest applications on optical data storage. Some preliminary results will be presented.

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