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FLUORIDE GLASSES FOR IR FIBERS

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A new family of multicomponent glasses based on fluorides of heavy metals has been reported previously, and offers the most promising prospects to date for high-performance mid-IR fibers. A variety of potential applications are envisioned for such fibers. Typical short-distance applications include laser surgery, laser printing, dissection and remoting of infrared focal planes, and infrared sensing. Long-distance applications include ultra-long repeaterless communication links and nuclear radiation resistant communications.

The compositional flexibility of heavy metal fluorides yields glasses with a broad (and controllable) range of optical transmission (0.3-8.0μm), refractive index, and mechanical strength.

A relatively simple apparatus has been designed for synthesizing glasses in a controlled environment at temperatures up to 1,000°C. The apparatus consists of a conventional argon-purged glove-box. A stainless steel furnace well, fasted to the side, extends into a resistance-heated furnace. Crucibles of Pt or vitreous carbon are attached to the end of a crucible rod which slides into the well. The melt is cast into various forms in a bronze mold, preheated to 50°C below the glass transition temperature of the material. The rapidly-quenched glass is also annealed in the mold.

Investigation into the ZrF_4-BaF_2- ThF_4 and ZrF_4-BaF_2-LaF_3 ternary systems reveals the existence of a vitreous area in a relatively broad range. Attempts at improving glass stability are made by doping additives into the base composition. In these zirconium fluoride glasses, LiF, NaF, or AlF_3 act as network modifiers and proved useful for supression of devitrification or for extension of glass working range.

IR spectra in the range 2.5-8.0μm was recorded on unpolished and polished samples in order to distinguish between absorption due to internal OH and surface OH. This absorption, which extends over the range 2.7-3.6μm, will have to be eliminated.

The correlation between the intrinsic multiphonon absorption and the glass composition is treated and explained in a theoretical setting.