Magneto-optic glass for fast infrared modulators

Martin Mika*[1], Frantisek Lahodny[1], and Kristyna Rysova[1]

[1]University of Chemistry and Technology Prague (UCT) – Technicka 5 16628 Prague, Czech Republic

Abstract

Fast infrared modulators, with a response time to an electric signal of less than 1 μs, are required for high speed processing of optical signals in free space communications. For these modulators, new materials with a high magneto-optic coefficient are needed. Because the magneto-optic coefficient of heavy metal glasses doped with magnetic spinel nanoparticles can reach very high values, these materials are promising for such application. In this work, we developed a new glass based on a PbO-Bi2O3-Ga2O3 system, which was doped with magnetic spinel nanoparticles. The glass was melted at 1000 ∘C for 40 min and then cast into a steel mould. Using the additions of Fe2O3 and/or NiO the spinel nanoparticles of a defined size were successfully precipitated during heat treatment. The magneto-optic coefficient of the glass was measured in an optical system comprising a laser source, a polariser, a chopper, a quarter wave plate, a glass sample, an analyser, a diaphragm and a detector with an amplifier. The laser light source was operated in a continuous regime at a wavelength of 2090 nm. The maximum of the transmittance peak was influenced by the magnetic field applied on the glass sample inside a solenoid electromagnet. From the rotation angle of the analyser, the magneto-optical coefficient was calculated. Its value was maximized by optimizing the glass composition and the heat-treatment process. Another advantage of this glass was that in the range of 550–2750 nm it had a transmittance of above 70 %, which is high enough to achieve low optical signal attenuation in the near infrared region. Collectively, our results indicate that the developed glass with magnetic spinel nanoparticles of the optimized size could be applied to the construction of fast infrared modulators.

Keywords: optics, magneto, optic glass

*Speaker