Session	Materials Science in Glass (II)
Date	APRIL 11, 2025
Time (CET)	12:10 - 12:25
Chair	Osman Burak Okan

(ONLINE)

Vanadate Glass as an Alternative for Radiation Hard Photonics and Optics

Owen McGann

Glass Technology Services Ltd, United Kingdom

Biography

Principal Technologist at Glass Technology Services with 10 years' experience in the development of glass materials for use as photonic gain material, including the development of a range of phosphate-based glass materials designed for use as gain materials in the NIR in a range of applications, including applications involving exposure to ionizing radiation. An experienced research scientist and expert in oxide glass materials, including silicate phosphate, borosilicate and tellurite glass systems, Dr McGann has developed a range of Er Yb cooped phosphate glasses optimized for use in Q-switched and mode locked laser systems. Dr McGann has led the development and establishment of GTS' photonic glass manufacturing capability, managing and supporting a series of six IUK funded, and Eureka funded collaborative R&D projects with industrial and academic partners from across the UK, setting GTS up as the UK's only commercial producer of laser gain glass materials.

Abstract

Vanadate glasses have been considered over the past 50 years as possible materials for use in near-infrared (NIR) and mid-infrared (MIR) optical materials. Due to the presence of vanadium in mixed oxidation states these glasses exhibit electrical conductivity and a high resistance to radiation driven defect formation. As such these materials are of interest for use in a range of applications including un-doped optical and doped solid state gain materials, suitable for use in laser and photonic devices in high radiation applications (e.g earth orbit).

The objective of this study was to optimise forming behaviour and optical transmission across a range vanadate glass compositions and to investigate their response to ionizing radiation, with a focus on alkali vanadate and phospho-vanadate systems relevant to optical applications.

Glasses were produced via melt-quench techniques under an oxidizing atmosphere, with samples cast and splat-quenched. A subset of the glasses were subjected to 0.6 MGy of irradiation using a laboratory X-ray source. The materials were analysed through FT-IR transmission, FT-IR reflectance spectroscopy and XPS spectroscopy in order to assess NIR and MIR transmission, structural modification, and the characterise the oxidation state of vanadium.

It was found that in alkali vanadate systems the use of high atomic mass alkali species increased both the thermal stability and optical transparency of the resultant glass materials. The phospho-vanadate system was found to possess superior glass forming behaviour but significantly reduced optical properties relative the alkali vanadate glasses. Radiation testing demonstrated that both vanadate glass systems exhibited a high resistance to ionising radiation damage. Consequently, these glasses have strong potential for use in radiation hard optical and photonic applications.