New tellurite glasses within the TeO2-NbO2.5-WO3 system: relevant correlations between structural and optical properties

Mohammed Zaki[1], Jonathan De Clermont-Gallerande[1], David Hamani*[1], Maggy Dutreilh-Colas[1], Jean-René Duclère[1], Tomokatsu Hayakawa[2], Olivier Masson[1], and Philippe Thomas[1]

[1]Institut de Recherche sur les Céramiques (IRCER) – Université de Limoges, Institut de Chimie du CNRS, Centre National de la Recherche Scientifique : UMR7315 – Centre Européen de la Céramique, 12 Rue Atlantis, 87068 LIMOGES CEDEX, France

[2]Nagoya Institute of Technology (NITECH) – Gokiso, Showa, Nagoya 466-8555, Japan, Japan

Abstract

Tellurium oxide based glasses have been of attractive scientific and technological interest due to their physical properties such as a high refractive index (around 2.2) high dielectric constants, a wide band infrared transmittance (up to 6 μm), a low phonon energy (600-700 cm-1) and large third order nonlinear optical susceptibilities $\chi(3)$ (50 times higher than those of silica-based glasses) [1-3].
The glass-forming domain of new glasses within the TeO2-NbO2.5-WO3 system was investigated. The structural evolutions upon adding NbO2.5 and WO3 were analysed using Raman spectroscopy; the linear and nonlinear optical properties were studied using optical transmission and spectroscopic ellipsometry. Consistent correlations have been revealed between structural and optical properties in these glasses.

Globally, no striking evolutions take place upon adding NbO2.5 and WO3. Adding WO3 leads to (i) uniformly dispersed WO6 octahedra throughout the Te–O–Te network (at low WO3 contents) and (ii) amorphous WO3-rich regions (at higher WO3 contents). Adding NbO2.5 engenders (i) a weak structural depolymerization of the Te–O–Te network and (ii) occurrence of NbO2.5-rich regions. The investigated glasses exhibit high linear refractive indices of 2.13 in average and remarkable nonlinear susceptibilities $\chi(3)$ of 5.48 *10-13 esu in average, i.e., about 37 times higher than $\chi(3)$ of silica SiO2 glass.

R. A. H. El-Mallawany, Tellurite Glasses Handbook: Physical Properties and Data, CRC Press, 2001.

A. P. Mirgorodsky et al., Phys. Rev. B 73 (2006) 134206.

S.-H. Kim et al., J. Am. Ceram. Soc. 71 (1993) 2486.

Keywords: tellurite glass, glass structure, linear and nonlinear optical properties, Raman spectroscopy

*Speaker