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White light generation controlled by changing the concentration of silver nanoparticles hosted by  $\text{Ho}^{3+}/\text{Tm}^{3+}/\text{Yb}^{3+}$  doped  $\text{GeO}_2 - \text{PbO}$  glasses

Mauricio E. Camilo, Elton de O. Silva, Luciana R.P. Kassab, José A.M. Garcia, Cid B. de Araújo

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Mauricio E. Camilo<sup>1,2</sup>, Elton de O. Silva<sup>1</sup>, Luciana R. P. Kassab<sup>1</sup>, José A. M. Garcia<sup>1,2</sup>, and  
Cid B. de Araújo<sup>3,\*</sup>

<sup>1</sup>*Faculdade de Tecnologia de São Paulo (FATEC-SP), CEETEPS/UNESP, São Paulo, SP, Brazil.*

<sup>2</sup>*Departamento de Engenharia de Sistemas Eletrônicos, Escola Politécnica da USP, São Paulo, SP, Brazil.*

<sup>3</sup>*Departamento de Física, Universidade Federal de Pernambuco, 50670-901 Recife, PE, Brazil.*

\*Corresponding author. E-mail: [cid@df.ufpe.br](mailto:cid@df.ufpe.br)

**Abstract**

Frequency upconversion (UC) experiments were performed with  $\text{GeO}_2\text{-PbO}$  glasses, containing silver nanoparticles (NPs), doped with holmium ( $\text{Ho}^{3+}$ ), thulium ( $\text{Tm}^{3+}$ ) and ytterbium ( $\text{Yb}^{3+}$ ) ions. The samples were excited using a continuous-wave diode laser operating at 980 nm. The UC intensities and the colors of the samples were controlled by changing the concentrations of the rare-earth ions (REI) and the silver NPs nucleated inside the samples. The colors observed spanned the visible range from the red-yellow to the blue.

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