SPATIOTEMPORAL MODELING OF MID-INFRARED PHOTOLUMINESCENCE FROM TERBIUM (III) ION DOPED CHALCOGENIDE-SELENIDE MULTIMODE FIBERS

S. Sujecki[1,2*], L. Sojka[1], Z. Tang[2], E. Barney[2], D. Furniss[2], T.M. Benson[2], A.B. Seddon[2]

[1]Department of Telecommunications and Teleinformatics, Faculty of Electronics, Wroclaw University of Science and Technology, Wyb. Wyspianskiego 27, 50-370 Wroclaw, Poland
[2]Mid-Infrared Photonics Group, George Green Institute for Electromagnetics Research, The University of Nottingham,University Park, NG7-2RD, Nottingham, UK

* corresponding author: *Slawomir.sujecki@nottingham.ac.uk*

Keywords: chalcogenide glass fiber, numerical modeling, photoluminescence, mid-infrared light

Mid-infrared (MIR) light has numerous applications in medicine, biology, agriculture, defense and security. Therefore in many laboratories intensive research is being carried out to develop MIR light technology in order to achieve a similar level of technological maturity as in the case of near-infrared and visible light wavelength ranges. One of the key elements of almost any device operating within the MIR part of the spectrum is the light source. There are several types of light source that have been developed for the generation of MIR light. These include the Globar©, quantum cascade lasers, inter-band cascade lasers, gas lasers, Raman lasers, optical parametric amplifiers, supercontinuum sources, lanthanide ion doped fiber lasers and fiber lanthanide ion doped spontaneous emission sources. This contribution is focused on the numerical analysis of the latter lanthanide ion doped spontaneous emission sources (LIDSES). LIDSES have been so far successfully implemented in optical sensors and sensor systems operating within the MIR wavelength range [1]. The operating wavelengths of LIDSES using chalcogenide glass can reach at least 5500 nm.

A spatiotemporal model is developed for studying the photoluminescence emitted from lanthanide ion doped chalcogenide-selenide glass multimode fibers. The modeling parameters are derived experimentally from in-house fabricated (at the University of Nottingham) lanthanide ion doped chalcogenide-selenide glass bulk and fiber samples. The set of partial differential equations which describes the spatiotemporal dynamics of photon populations and ionic level, electronic state populations is solved numerically using the Method of Lines [2]. In particular, spatiotemporal dynamics within a terbium (III) ion doped chalcogenide-selenide glass multimode fiber are studied. The results obtained show the time dependence of the light emitted from the fiber ends and also the dependence of light emitted through the sides of the fiber on the shape of the temporal waveform of the photon flux generated by the pump laser.

[1] F. Starecki, et al. Sensors and Actuators B-Chemical, **207** (2015), 518

[2] S. Sujecki, J. Opt. Soc. Am. B, 33 (2016), 2288

PRESENTATION TYPE: ORAL X

POSTER