

# All-fiber Er:ZBLAN lasers in hybrid geometry

K. Anders<sup>1</sup>, A. Jusza<sup>1</sup>, P. Komorowski<sup>1,2</sup>, U. Zdulska<sup>1</sup>,  
T. Osuch<sup>3</sup>, K. Markowski<sup>3</sup> and R. Piramidowicz<sup>1,\*</sup>

<sup>1</sup>*Institute of Microelectronics and Optoelectronics, Warsaw University of Technology, Warsaw, Poland.*

<sup>2</sup>*Faculty of Physics, Warsaw University of Technology, Warsaw, Poland.*

<sup>3</sup>*Institute of Electronic Systems, Warsaw University of Technology, Warsaw, Poland*

\* *Corresponding author: [r.piramidowicz@elka.pw.edu.pl](mailto:r.piramidowicz@elka.pw.edu.pl)*

Erbium doped ZBLAN glass fibers are continuously considered as a promising active media enabling efficient coherent emission within visible and infra-red spectral range. Rich structure of energy levels of erbium offers relative simplicity of excitation using commercially available laser diodes, while low phonon ZBLAN matrix provides longer fluorescence lifetimes of metastable levels. For that reasons, it is expected that Er:ZBLAN system should offer excellent lasing properties, both in IR and visible spectral range. Surprisingly, despite the confirmed lasing potential in green [1] and mid infrared [2], the laser action in near IR (1.55  $\mu\text{m}$ ) spectral range has not been reported so far in singly doped Er:ZBLAN system (there are only reports concerning infrared lasing in Ce+Er:ZBLAN).

Main aim of this work was to develop and check the lasing properties of an all-fiber lasers in a hybrid geometry, based on combination of Er:ZBLAN active fiber and silica fiber-based passive components. Such a hybrid design may enable simultaneous benefiting both from excellent luminescent properties of erbium doped ZBLAN glass and all advantages of low-cost, reliable and easily manufactured fiber-optic components made of silica glass and deployed as a remaining elements of resonator, including fiber Bragg gratings (FBGs) used as highly selective mirrors for IR or green spectral range. Two all-fiber lasers based on combination of erbium-doped ZBLAN and passive silica fibers and optimized for operation in IR and green spectral range were set up and carefully examined under various pumping conditions. In particular, 1490 nm and 980 nm pumping have been used for investigating the lasing at 1535 nm, while for lasing in green the up-conversion pumping at 980 nm and direct pumping at 520 nm have been tested. Performance parameters of laser action have been measured and compared with numerical computation.

As a result – the lasing at 1535 nm was obtained both for 1490 nm and 980 nm pumping, according to the best knowledge of authors for the first time in ZBLAN material. The lasing experiments in green spectral range with the unique short wavelength FBG resonator are still in progress and will be reported and compared with state-of-art results during the conference. The results obtained so far confirm in general the applicability and usefulness of hybrid fiber laser design, giving an excellent starting point for further development of this type of lasers.

*Keywords:* erbium, ZBLAN, fiber laser, VIS, NIR

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## References

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