FUNCTIONAL OPTICAL MATERIALS FOR APPLICATIONS IN NEW SENSORS CONSTRUCTIONS

Piotr Miluski[a]*, Marcin Kochanowicz[a], Jacek Żmojda[a], Agata Baranowska[b], Dominik Dorosz[c], Jan Dorosz[a]

[a] *Faculty of Electrical Engineering, Bialystok University of Technology, Wiejska 45D, 15-351 Bialystok, Poland*
[b] *Faculty of Mechanical Engineering, Bialystok University of Technology, Wiejska 45C, 15-351 Bialystok, Poland*
[c] *Faculty of Materials Science and Ceramics, AGH University of Science and Technology, 30 Mickiewicza Av.,30-059 Krakow, Poland*
e-mail: p.miluski@pb.edu.pl

The photonic materials development is a key enabling new optical technologies. A good example are optical fibers currently used in telecommunications, optical amplifier constructions, lasers and measurement systems [1-4]. They are based mainly on inorganic glasses (silica and multi-component glasses) and optical polymers. Sophisticated optical fibre constructions (sensitive coatings, capillary, and photonic crystals structures) are widely used for optical sensors due to a long interaction distance inside the waveguideing structure. The advantages of optical fibres (flexibility, mechanical stability, small dimensions, and electrical resistivity) can be used in new sensing applications development. New functional materials can significantly improve sensors sensitivity and reliability. The constructions of optical fibre sensors developed in the Bialystok University of Technology will be presented and discussed.

The possibility of functionalization of optical fibers is depended on the used matrices. Despite the advantages of glass matrices (low attenuation, good thermal stability, and high optical power damage threshold), the functional properties of optical fibers can be obtained by inorganic dopants. Due to the high temperature necessary for glass fiber fabrication, the possibilities of doping with organic compounds are very limited. The new construction of optical fibers sensors based on the active glass will be discussed. The Tb^{3+} doped active core/ribbon in the construction of UV side-detecting optical fiber will be presented [5]. Additionally, the temperature-sensitive optical fibre sensor based on the Nd^{3+} emission will be shown. The change of luminescence intensity of neodymium at the wavelength of 880 nm and 1060 nm was used for temperature monitoring inside the Carbon Fiber Reinforced Polymer (CFRP) in the temperature range 30–75ºC [6].

Another group of photonic materials - polymers offers a wide range of applications resulting from the possibility of their functionalization with organic dyes and lanthanide compounds. This is possible due to the low temperatures necessary for synthesis and thermoforming, as well as the availability of various methods of incorporation of dopants in the polymer host. Due to the wide range of active dopants, functional properties of polymer optical fibers can be obtained (e.g. luminescent, photochromic, thermochromic). New constructions of polymer optical fibre sensors will be presented. The poly(methyl methacrylate) (PMMA) fibers based on the Eu^{3+} organometallic complex for 355 nm laser radiation measurement in the range 5.0–34.0 mW will be presented [7]. Additionally, luminescent (Rhodamine B doped) polymer optical fibre sensor for temperature measurement in the range 20-70 C will be discussed [8]. Moreover, the incorporation of Spirooxazine and 1,4-Bis(2-methylstyryl) benzene in PMMA fibre can be used for obtaining photochromic properties inside the optical fibers. The presented environmental sensitive optical fibres are an interesting proposition for new constructions of optical fibre sensors.

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