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WAVEGUIDE LASER BASED ON MESOSCOPIC ORDERED HYBRID TITANIA AND SILICA SOL-GEL FILMS

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Nanoscale hybrid films manifest a set of properties that can beneficial when used in dye lasers, amplifiers, switching devices, solar cells, OLEDs. Studies on the fabrication of sol-gel optical hybrid SiO2 and TiO2 films for photovoltaic devices or planar optical waveguide are continuously caring attention over the years because this materials have numerous applications in the field of microelectronics and optoelectronics. We have studied the characteristics of thin hybrid films which could be useful to tune the quality of mesoscale surface and developed the self-assembly approach based on the sol-gel method to fabricate of high-quality hybrid nanocomposite films using network-forming oxides such as silica or titanium [1-2]. In the frame of given approach the optically transparent, low roughness hybride silicate and titanium films of the nanoscale thickness have been manufactured and have been studied their luminescence property in the broad concentration range [3]. This property of the nanoscale hybrid films was the one of reason to harness them as laser media [4]. The main target of our work was consisted in studying planar waveguide lasing based on the structured hybrid films at its nanoscale thickness. For both films, we observed lasing, which appears as a radiation of the central beam due to the enhanced luminescence (along with the track) and a lasing that occurs due to the distributed grating feedback of the enhancement created by the oncoming waves of the enhanced luminescence. In case of a TiO2 film, it was found that the radiation that emerges from the strip ends sharply with a narrow spectrum under pumping above 0.2 MW/cm2 what is close to the lasing spectrum of the conventional dye laser. The observed narrow directivity in a transverse direction is very surprising because the diffraction should cause this directivity to be much wider. One possible explanation of the narrow directivity is the formation of a thermal lens caused by the transversal temperature gradient. Our estimations show that the thermal lensing may be effective for thin films even for the low intensity lasers. These results show a possibility for a high-quality lasing on the basic mode of a waveguide that forms the central beam.

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