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Nd:LaF_3 Channel Waveguide Lasers fabricated by Molecular Beam Epitaxy

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Abstract

We report the first laser operation of slab-loaded channel waveguides based on Nd:LaF_3 thin films grown by molecular beam epitaxy. Two different methods of channel fabrication in this low phonon energy material are discussed.

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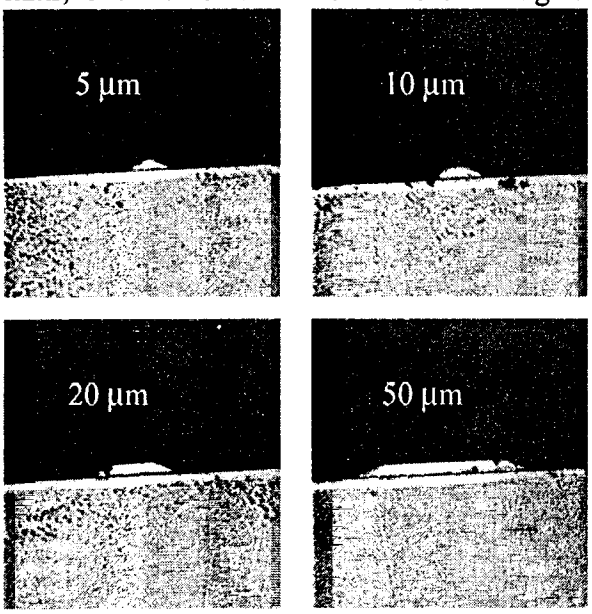
Summary

Lanthanum fluoride, has a number of properties that make it an attractive host material for rare-earth (RE) lasing dopants. It has a very low maximum phonon energy (~380 cm^{-1}) and a large transparency window, leading to the possibility of accessing RE transitions that normally suffer from efficient non-radiative decay in other hosts. Combination with a waveguide geometry, could lead to efficient, low threshold, integrated devices that operate over a wide range of wavelengths. Recently we demonstrated the first laser action in a neodymium-doped lanthanum fluoride planar waveguide [1]. This was the first laser action achieved in a RE-doped, fluoride thin-film fabricated by molecular beam epitaxy (MBE). The fabrication technique allows very accurate control of the thickness and doping level of the thin-film, and potentially also over the doping and refractive index profiles. Here we report on investigations into producing slab-loaded channel waveguide lasers based on these MBE planar thin-films, to further lower the laser threshold and give a more circular spatial output. The first fabrication technique reported, employs an organic photo-definable polymer (DOW chemical: benzocyclobutene) that can be processed using standard photolithographic techniques to produce the type of structures shown aside, where various width polymer strips are laid over the Nd:LaF_3 thin film. Although benzocyclobutene's potential for producing integrated optical devices is well recognised [2] we believe that this is the first demonstration of active laser channels that incorporate this polymer. We report laser operation at both 1.06μm and 1.3μm, with thresholds as low as 15mW (incident power) for these structures. We also report the fabrication and laser operation of channels produced by etching via ion beam milling through a CaF_2 upper cladding. The prospects for the future development of mid-IR laser sources based on this technology will be discussed.



References

[1] E.Daran, D.P.Shepherd, T.Bhutta, and C.Serrano, "*Laser operation of a Nd:LaF_3 thin film grown by molecular-beam epitaxy*," Electron. Lett. 1999, Vol.35, pp.398-400.

[2] C.F.Kane and R.R.Krchnavek, "*Benzocyclobutene Optical Waveguides*," IEEE Photon. Technol. Lett. 1995, Vol.7, pp.535-537.

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May be scheduled for poster presentation if oral presentation is not possible

13. Waveguide lasers, fibre lasers and amplifiers