Researchers report innovative solid state fluoride ceramic lasers

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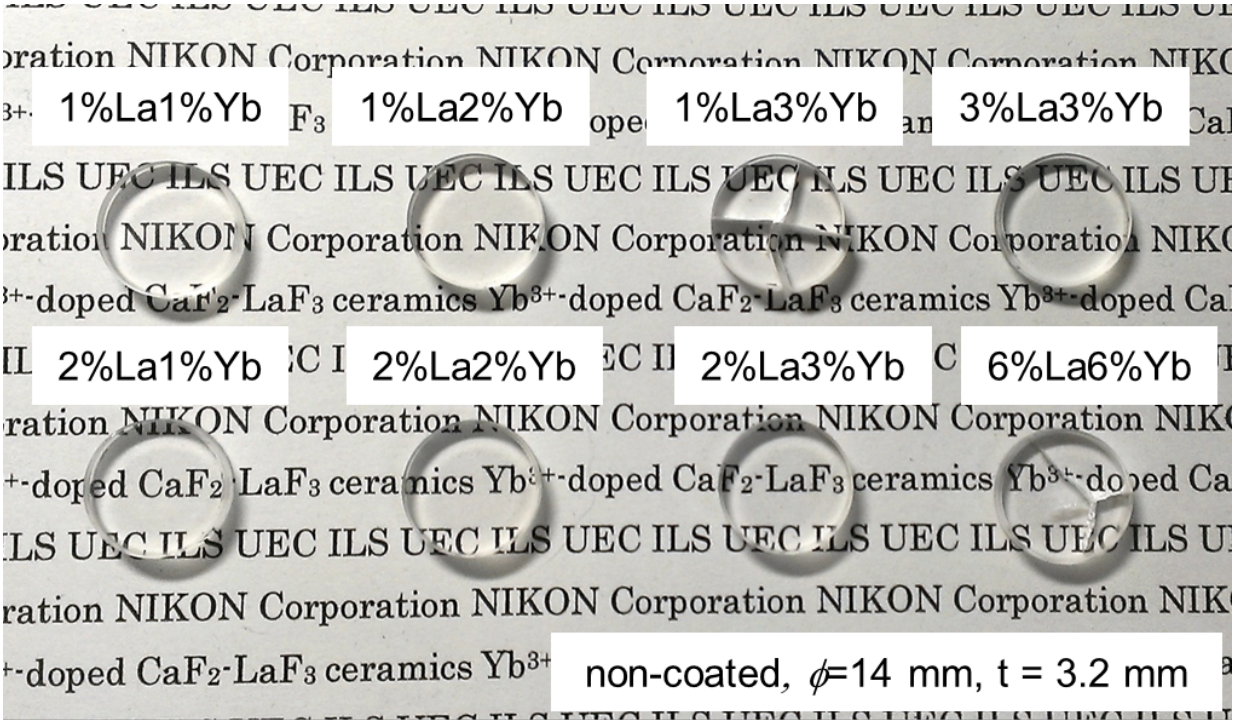

Yb:CaF_2-LaF_3 ceramic samples with different combinations of doping concentrations. Credit: University of Electro Communications

Polycrystalline ceramic materials offer advantages including robustness over conventional glass as gain media for solid state lasers: devices that find many applications such as laser processing and medical surgery.

Recently, there has been renewed interest in fluoride ceramics lasers for ultrashort pulse laser oscillators/amplifiers. Here, Shotaro Kitajima at the University of Electro-Communications, Tokyo, Hitoshi Ishizawa at Nikon Corporation, and colleagues report on the development of the first Yb^{3+}-doped CaF_2-LaF_3 ceramic laser with a maximum power output of 4.36 W and slope efficiency of 69.5%.

Kitajima and colleagues fabricated CaF_2 ceramics doped with two rare earth ions of La and Yb from 1 at. % La^{3+}, 1 at. % Yb^{3+} to 6 at. % La^{3+}, 6 at. % Yb^{3+}. The doping was carried out using a wet process to mix CaF_2 with two kinds rare-earth fluorides with average diameters of 200 nm. This was followed by sintering first between 750°-900° in air followed by the hot isostatic pressing method between 700°-1000° in an inert atmosphere.

Notably, the random orientation of the axes of grains in ceramics improves their mechanical robustness, which is one of the main motivations for producing CaF_2 ceramics for gain media.

The findings described in this paper show that it may be possible to significantly improve the physical properties of Yb: CaF_2-ceramic materials for high performance laser gain media.

More information: Shotaro Kitajima et al. Yb^3+-doped CaF_2-LaF_3 ceramics laser, *Optics Letters* (2017). DOI: 10.1364/OL.42.001724

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