STUDY OF FLUORIDE CRYSTALS GROWTH AND COLOR CENTER PRODUCTION BY HIGH-INTENSITY ULTRA SHORT LASER PULSES

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Fluoride crystals have long presented a challenge for chemists and physicists, because their preparation often requires very specific procedures [1]. In spite of this, fluoride crystals have found many applications as dosimeters, information storage devices, x-ray monochromators, and, in particular, in the field of optics as laser media.

Color centers are lattice vacancies defects trapping electrons or holes. They are easily created in single crystals at room temperature, by irradiation with ionizing radiation. Recently it was shown that is possible to create, with dimensional control, color centers with interaction of ultra short pulse laser in crystals and glasses [2]. This action allows the modulation of the material refraction index, creating waveguides or photonics devices [3].

The laser performance of fluoride crystals is dependent upon a number of factors directly related to the crystal growth conditions and laser operation. For example, the presence of oxygen impurities and/or moisture during crystal growth can change considerable the defects formation as well as the optical response of such devices. Moreover, when laser crystals are exposed to high intensities of pumping radiation in the UV-visible spectral regions or ionizing radiation, degradation of their characteristics and performance are implies.

Color centers are used as a probe to understanding the relevance of laser-degradation process in crystals. In this work, we show that is possible to produce stable color centers inside fluoride crystals ($LiYF_4$, $BaLiF_3$, $LiSrAlF_6$, LiF) with dimensional control. Besides, high intensity lasers produce color center aggregates, that are suitable for laser action. Ti:Sapphire CPA laser system operating at 830nm was used, producing a train of 640 mJ, 60fs pulses at 1kHz, with a peak power of 12.5GW. A comparison between the optical properties of color centers produced by ultrashort laser irradiation in samples grown by different methods was done, and it was possible to discuss the basic formation mechanisms of these centers. The optical absorption spectra of the produced color centers was measured.

References

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