CONFOCAL MICROLUMINESCENCE STUDIES OF LASER ASSISTED MICROMODIFICATIONS IN TRANSPARENT CRYSTALS

A. Ródenas\textsuperscript{1}, D. Jaque\textsuperscript{1}, G. A. Torchia\textsuperscript{2}, C. Mendez\textsuperscript{2}, L. Roso\textsuperscript{2}, S. Lauzurica\textsuperscript{3}, C. Molpeceres\textsuperscript{3}, F. Agulló-Rueda\textsuperscript{4}

\textsuperscript{1}Departamento de Física de Materiales, C-IV, UAM, 28049 Cantoblanco (Madrid), Spain
\textsuperscript{2}Grupo de Óptica, Departamento de Física Aplicada, Facultad de Ciencias Físicas, Universidad de Salamanca, Plaza de la Merced s/n 37008 Salamanca, Spain
\textsuperscript{3}Centro Láser U.P.M., Edificio Tecnológico "La Arboleda", Campus Sur U.P.M. , Carretera de Valencia km. 7,300, 28031 Madrid, Spain
\textsuperscript{4}Instituto de Ciencia de Materiales de Madrid (CSIC), Cantoblanco, E-28049 Madrid, Spain

KEYWORDS: Micro-luminescence confocal microscopy, luminescence of rare earth ions

Laser writing with short and ultrashort laser pulses has been recently demonstrated to be an efficient technique for creating a wide variety of photonic, electronic and mechanical devices in transparent materials. Among all of these applications those lying in the photonic and optoelectronics area are of special relevance due to the increasing demand for new optical microstructures. A variety of devices based fabricated with this technique have been demonstrated in different materials including waveguides, diffractive elements, photonic structures\textsuperscript{1} and binary data storage elements. Transparent crystals with high refractive index and large transparency ranges are ideal candidates for photonic applications. In order to develop any of the above mentioned applications a good knowledge concerning how the properties of the crystal are modified by the laser writing process is required. Since the typical electron-phonon coupling time of dielectrics is on picosecond range, the light-matter interaction dynamics will strongly depend on whether the laser pulse duration is higher or lower than this time. For this, the possible effects created on the irradiated material or its surroundings need to be investigated.

We propose a new approach to this problem consisting on the use of optically active ions, such as Nd\textsuperscript{3+} ions, as optical probes. In this work we show recent data concerning confocal microscopy experiments performed in femtosecond and nanosecond irradiated Nd\textsuperscript{3+} doped transparent media. These experiments have been used to get a spatial location of laser assisted micro-modifications at the micrometric scale. We have been able to detect the presence of lattice compressions, material amorphization and complete luminescence inhibition. The information obtained from confocal micro-luminescence experiments have been compared to that obtained from micro-raman experiments. Conclusions obtained from both techniques have been found to be in good agreement.