Use of polyvinylpyrrolidone in the $LiNbO_3$ thin films deposition

Dana Mikolášová[1], Kateřina Rubešová[1], Vít Jakeš[1], Tomáš Hlásek[1], and Jiří Oswald[2]

[1] *University of Chemistry and Technology, Technická 5, Prague 6 166 28, Czech Republic*
[2] *Institute of Physics, the Academy of Sciences of the Czech Republic, Cukrovarnická 10, Prague 6 162 00, Czech Republic*

Lithium niobate belongs to the group of the most important crystalline materials. This ferroelectric material with the Currie temperature of 1150 °C is mostly used in acusto-optic devices, optical waveguides, nonlinear optics and pyroelectric sensors. Its applications are extended using rare earth ions doping. $LiNbO_3$ is prepared in the form of monocrystals, optical fibers or thin films. The thin films are produced by various methods – e.g. ion implantation, liquid phase epitaxy (LPE), pulsed laser deposition (PLD), molecular beam epitaxy (MBE), chemical vapor deposition (CVD), physical vapor deposition (PVD) or a sol-gel technique. Due to the Er^{3+} ion luminescence, the doped $LiNbO_3$ can be used in the IR region for the amplification of optical signal in the third telecommunication window (1525 nm). The co-doping of Er^{3+} and Yb^{3+} ions increases the intensity of the Er^{3+} luminescence due to energy transfer between the excited states of both ions.

This work presents the preparation of $LiNbO_3$ thin layers doped with 0.5 at % of Er^{3+} and 0.5 at % of Yb^{3+}. The layers were deposited on a sapphire (0001) substrate by spin-coating. Used solutions were prepared by a non-aqueous sol-gel method using a 2-methoxyethoxide solution of present cations and polyvinylpyrrolidone (PVP). The influence of different PVP molar mass (29 000 or 360 000 g/mol) on the final microstructure was tested. Then the effect of different annealing of the deposited films (one- or two-step) was examined. Its influence on the film crystallinity, on the Er^{3+}/Yb^{3+}: $LiNbO_3$ luminescence and waveguiding properties was investigated. The thin films were characterized by the photoluminescence and transmittance spectroscopy, m-line spectroscopy, X-ray diffraction analysis, scanning electron microscopy, atomic force microscopy and thickness measurement.

This work was financially supported from specific university research (MSMT No 20/2015)