Thin films of lithium niobate prepared by sol-gel method

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Lithium niobate thin films doped by f-elements are widely used in waveguiding technologies. The films are produced by various methods – e.g. an ion implantation to a monocrystalline substrate, a pulsed laser deposition or a sol-gel technique. The sol-gel preparation of doped lithium niobate mainly uses alkoxide solutions. The metal alkoxides derived from primary lower alcohols are commercially available; however, they are highly reactive and water sensitive. Therefore less reactive derivatives must be prepared – e.g. the alkoxides of 2-methoxyethanol. These alkoxides are more stable in time and are less sensitive to hydrolysis. Their higher stability is caused by lowered polarity of metal-oxygen bond in 2-methoxyethoxide that moreover plays the role of bidenate ligand and thus spatially hinders metal centre from hydrolysis.

In this work, we present various syntheses of 2-methoxyethoxides of Li and Nb. Also alkoxides of Er and Yb were prepared and used at doping with these laser active ions. Precursor solutions were further used for the synthesis of mixed alkoxide $LiNb(OCH_2CH_2OCH_3)_6$. The solutions were applied at thin films preparation using dip- or spin-coating techniques. Li/Nb solutions were coated on sapphire (0001) substrates. Many parameters of coating techniques were optimized – e.g. spin speed, pull-out speed, the volume of spin-coated solution, the regime of the following thermal treatment etc.

We prepared the monophase polycrystalline thin films of $LiNbO_3$ oriented according to the sapphire substrates – i.e. $LiNbO_3$ (006) layers. We established dependence of thin film thickness on deposition parameters and on the number of coatings. Different recrystallization treatments were compared in order to enhance the microstructure and crystallinity of deposited films.