MS Thesis Defense
Electro-Optics and Photonics
University of Dayton
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All are welcome to attend

Growth of Optical Quality Lead Magnesium Niobate-Lead Titanate Thick Films

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Abstract

Lead magnesium niobate-lead titanate (1-x)[Pb($Mg_{1/3}Nb_{2/3}O_3$]-x[$PbTiO_3$] (PMN-PT) is a relaxor ferroelectric crystal that has many uses, specifically in non-mechanical beam steering for use in Light Detection And Ranging (LIDAR) assemblies, or other optical devices, such as free space laser communication. When using bulk PMN-PT the voltage required to steer a beam can be in the kilovolt range. However, with unique designs, optical quality PMN-PT polycrystalline thick films (5-50μm thick) could be used in order to minimize the voltage required for beam steering projects to less than 100V. Steering an optical beam requires a change in index of refraction, which is dependent on the electric field. The required voltage to produce an electric field is dependent on the thickness of the field region, so thinner regions between electrodes will result in lower required voltage to produce the same electric field, and therefore the same change in index of refraction. In the present research, PMN-PT polycrystalline thick films were grown on strontium titanate ($SrTiO_3$), lanthanum aluminate ($LaAlO_3$), and platinum substrates, via a modified sol-gel method. These films were deposited by a dip-coat method and annealed by a fast-fire method. This experiment resulted in a measured value for the Pockels effect coefficient, r_{13}, of 392pm/V while only applying 23V across the crystal.