Lithium Niobate: From materials preparation to the design of periodic polarization device

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The lithium niobate (LiNbO3, LN) single crystal is an ideal material with the combination of good piezoelectric, electro-optical, acousto-optical, and nonlinear optical properties. Especially in nonlinear, it is honored as optical silicon. As is well-known, the congruent LN crystal (CLN) shows a large number of intrinsic defects, which limits its optical applications significantly. Two approaches to eliminate these intrinsic defects and to improve the optical properties of LN single crystals are the growth of Mg-doped CLN crystals and near-stoichiometric LN single crystals (NSLN). In this work, we would give a comprehensive introduction from preparation of LN polycrystalline materials to the fabrication of devices based on periodically poled lithium niobate (PPLN). The doped LN or a large size SLN single crystal was successfully grown by the Czochralski method, using the proposed homogeneous ion doping techniques, the wet-chemical method and the partial wet-chemical method. The corresponding optical superlattice materials were prepared by the autonomous technique, also, the fabrication of PPLN-based series of nonlinear optical devices, such as high efficiency green laser, tunable mid-infrared laser, antiproton exchange waveguide and single-photon detector.