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**Ferroelectric thin films for electro-optic modulators, piezoelectric actuation and nonlinear optical conversion**

Abstract:

Preferentially oriented ferroelectric thin films with high quality can be deposited on almost any substrate when using a suitable lanthanide based thin intermediate layer. The films are deposited using a chemical solution deposition method, developed at Ghent University. Both lead zirconate titanate (PZT) and barium titanate (BTO) deposited with this process show excellent oriented growth. Such thin films are interesting for a number of applications because they exhibit strong electro-optic coefficients, piezoelectric coefficients and a strong second order nonlinear susceptibility. Measurement of the electro-optic coefficients reveal that PZT layers can be poled once and retain their high electro-optic coefficient, which means that no constant DC voltage is required for electro-optic modulation. PZT based electro-optic modulators have been integrated onto a SiN photonic platform and high-speed electro-optic modulators have been demonstrated with a bandwidth of up to 30 GHz. Similar modulation of waveguides is also possible by using the piezoelectric effect. Surface acoustic waves are generated inside the PZT thin film and are used to modulate an optical signal through the acousto-optic effect. Finally, it has also been demonstrated that the PZT thin films exhibit a very strong second order susceptibility of 128 pm/V. The sign of the susceptibility can be changed by applying DC voltages which opens up the possibility of quasi-phase matching.