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**Fabrication of graded index single crystal (GRISC) in glass**[1]
KEITH VEENHUIZEN, SEAN MCANANY, Lehigh University, DANIEL NOLAN, BRUCE AITKEN, Corning Inc., VOLKMAR DIEROLF, HIMANSHU JAIN, Lehigh University — Spatially selective femtosecond laser induced crystallization of glass offers a compelling opportunity to expand integrated optics into dense, 3D geometries. Compared to polycrystalline lines, laser induced single crystal waveguides possess lower scattering losses, but they still suffer from losses at the crystal-glass interface due to the step-index profile and non-uniform interface. To correct this problem, we attempted to control the crystal growth dynamics and create waveguides with better transmission. We tuned the laser scanning speed and power to control lithium niobate crystal growth in 35Li2O-35Nb2O5-30SiO2 glass, such that nucleation and growth occur upon heating and ahead of the laser focus. This growth mode was verified via electron backscatter diffraction measurements of crystal cross-sections, which exhibited a symmetric, gradually varying lattice misorientation with respect to the c-axis orientation in the center. Theoretical simulations predict that such misorientation would decrease the refractive index of the crystal line from the center moving outwards. This graded refractive index single crystal waveguide in glass would improve transmission by a reduction in scattering at the crystal-glass interface due to tighter optical confinement in the crystal core.

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