Quasi-phase matched optical parametric oscillators using periodically poled KNbO$_3$ crystals

KNbO$_3$ is one of the best materials for efficient nonlinear frequency conversion, due to its large nonlinear optical coefficient ($d_{33} = 20.6$ pm/V$^3$) and transparency range (0.4 – 5 µm) and freedom from photorefractive effects. Quasi-phase-matched second harmonic generation using periodically poled KNbO$_3$ (PPKN) crystals has been reported$^{3, 4}$. Here we report on fabrication of PPKN and demonstration of a pulsed optical parametric oscillator (QPM OPO) pumped by an Nd:YAG laser. Single domain KNbO$_3$ crystals of 11×14×6 (a×b×c) mm$^3$ size were fabricated by applying an electric field of 500 V/mm along the c-axis at 170°C for 13 hours. Using the single domain KNbO$_3$ crystal plates, periodically poled structures were fabricated by applying a square pulse with a peak intensity of 280 V/mm and a pulse width of 730 ms. A periodically poled KNbO$_3$ of good quality was obtained with a dimension of 5.0×2.2×0.7 (a×b×c) mm$^3$ and a period of 31.5 µm, which is to utilize the $d_{33}$ component of the second-order nonlinear coefficient tensor. Optical parametric oscillation was realized at the signal wavelength of 1.56 µm using an Nd:YAG laser as a pumping source. The result of this work may contribute to the development of coherent radiation sources in mid-IR region.

![Fig. 1 Etched domain patterns of (a) +c, (b) -c faces of PPKN.](image-url)
Fig. 2 Signal power of PPKN OPO as a function of pump power.

Fig. 3 Tuning curve of PPKN OPO.

Fig. 4 Efficiency of PPKN OPO