3.5 Frequency Doubling of AlGaAs Laser Diodes in $KNbO_3$ Waveguides

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A compact solid-state source of coherent blue radiation is of considerable technological interest in certain low-power applications such as optical data storage, xerography and spectroscopy. At present, there are no reliable electrically pumped cw laser diodes available that emit in the blue spectral range and operate at room temperature. Several approaches have been described for generating blue and green light by frequency doubling near infrared laser diodes in nonlinear optical materials.

We demonstrate the generation of 430 nm radiation by frequency doubling of a laser diode in a $KNbO_3$ waveguide in the Cerenkov configuration. We used a 150 mW cw AlGaAs laser diode (SDL 5422), an ion-implanted $KNbO_3$ channel waveguide, and an external grating in an extended-cavity configuration to provide feed-back for stabilising the emission wavelength of the laser diode. A maximum blue output of 0.5 mW was generated at 430 nm with about 50 mW of the fundamental power coupled into the channel waveguide. The corresponding normalised conversion efficiency was 20 $\%W^{-1}$.

Further optimisation of the implantation process, the post-implantation annealing and repoling should increase the conversion efficiency by a factor of five. Therefore, we estimate that up to 5 mW second harmonic blue light can be generated by frequency doubling a 200 mW single mode laser diode in an optimised 1 cm long $KNbO_3$ channel waveguide.