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"Diode-pumped Solid-state Lasers"

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Diode-pumped Solid-state Lasers

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Diode lasers

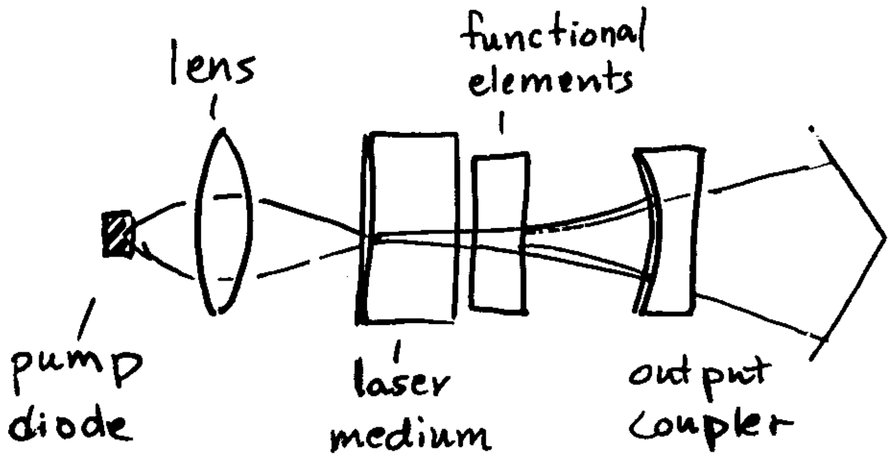
- efficient electron to photon converters > 30%

- high powers
  - broad stripe lasers 1 - 10 W
  - arrays 10 - 100 W
  - stacked arrays quasi cw 10 kW

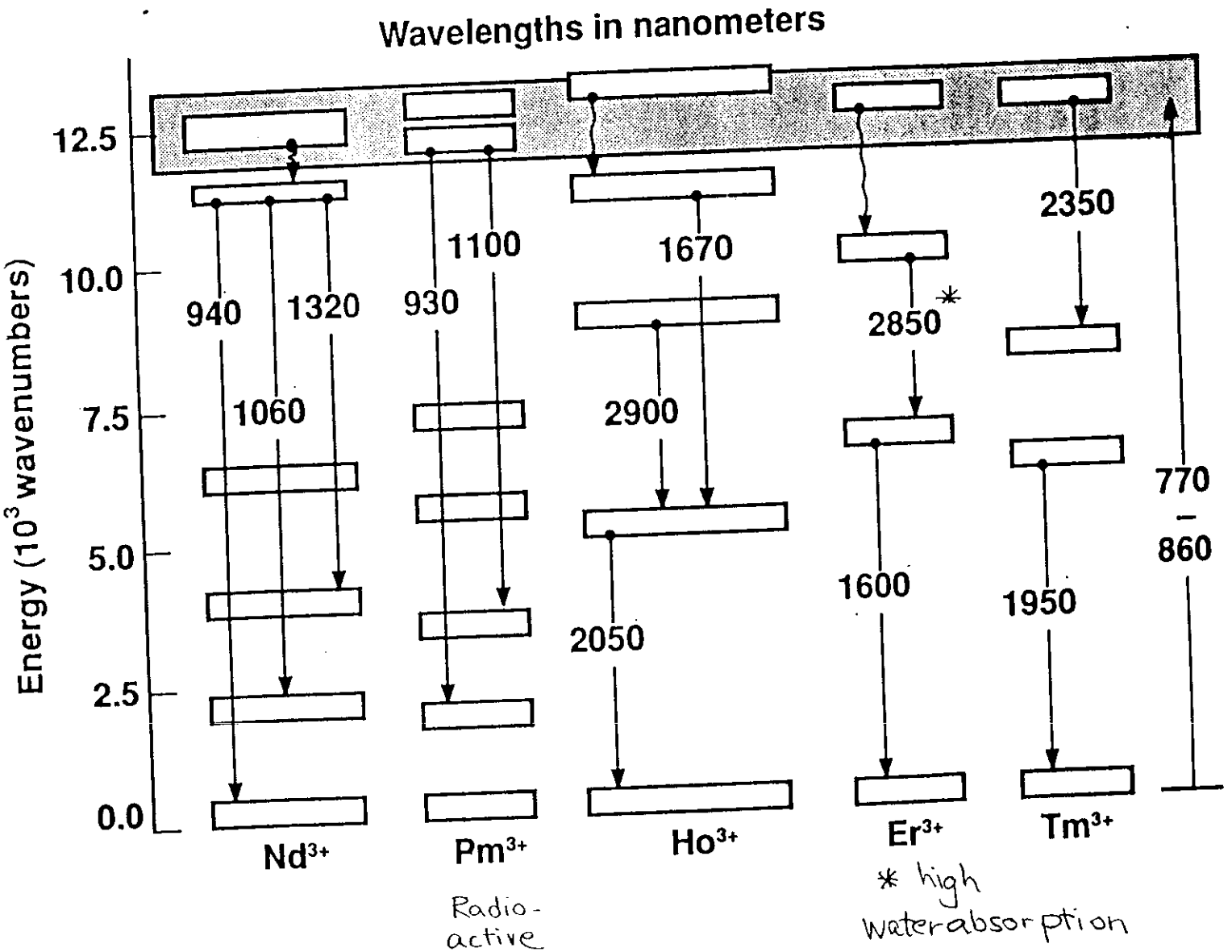
- astigmatic beam 10° by 30°

- broad bandwidth 3 - 10 nm

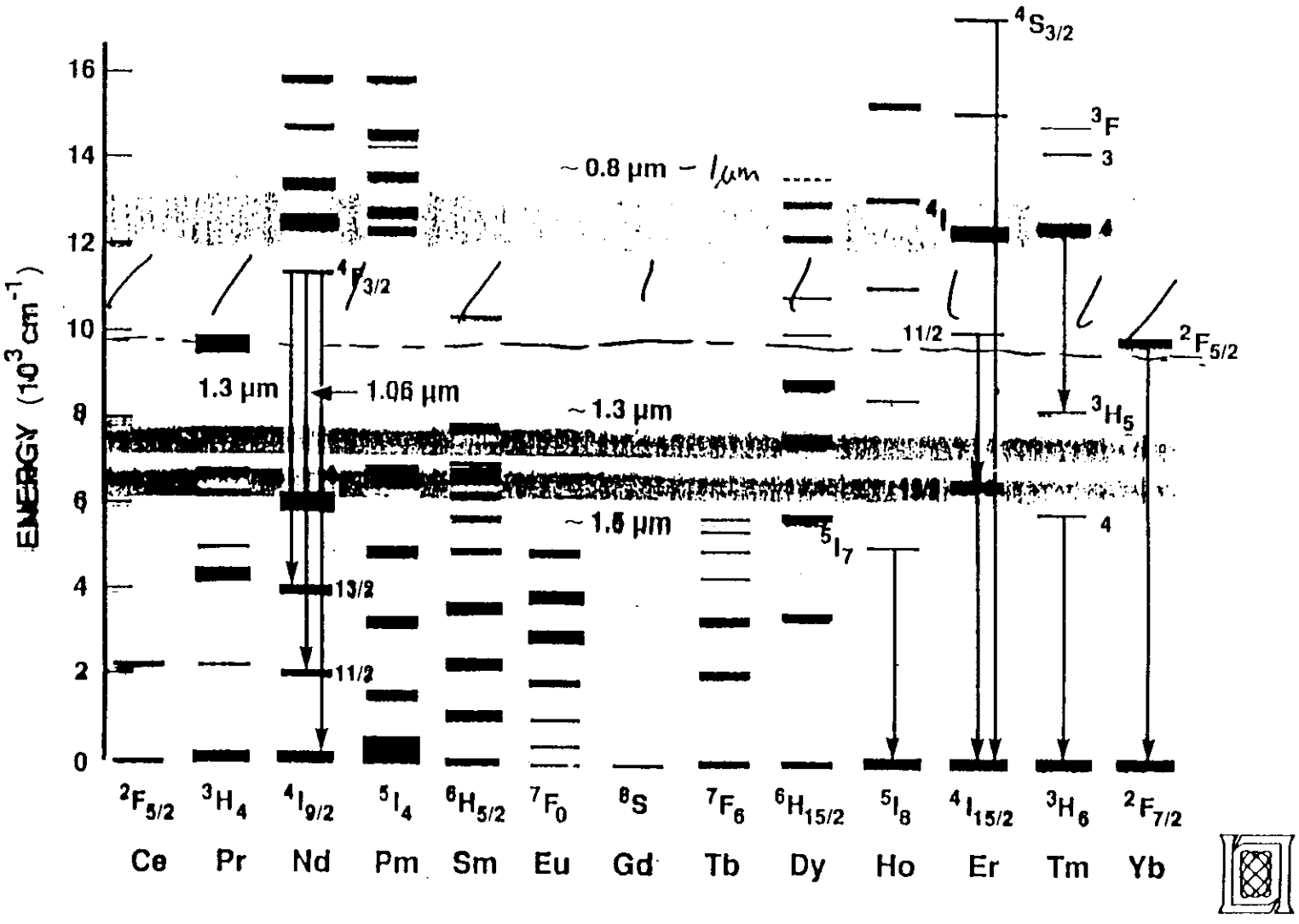
Diode pumped laser



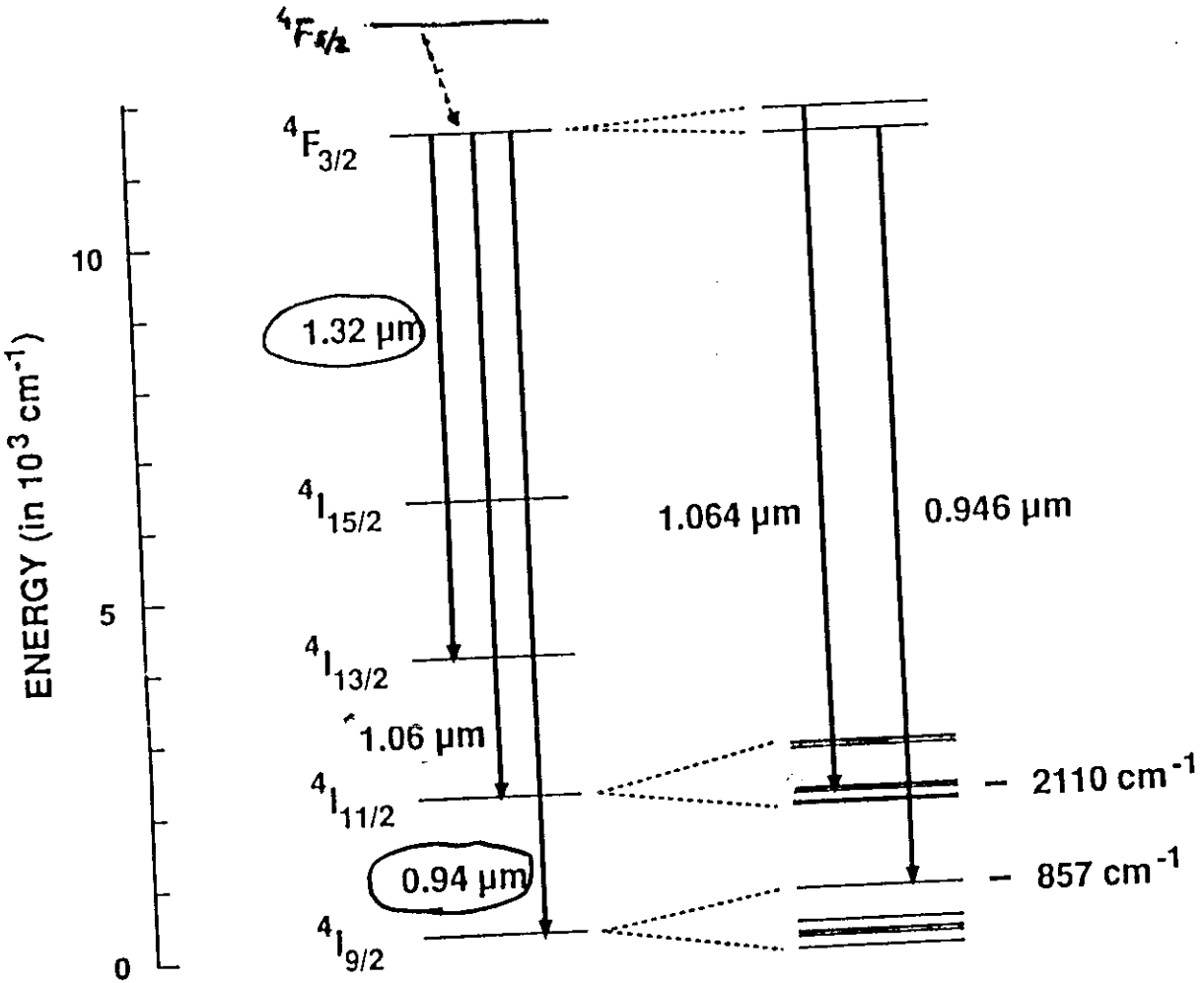
AlGaAs diode array pumped RE^{3+} ions



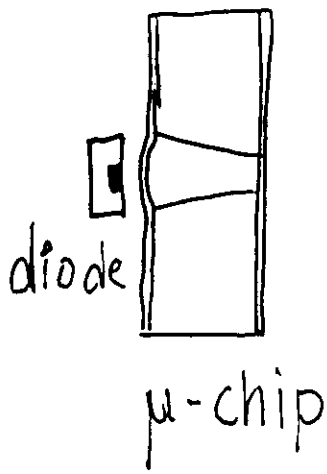
ENERGY LEVELS OF RE^{3+} IONS



Nd:YAG ENERGY LEVEL DIAGRAM



Simplest diode pumped solid-state laser



- ~ gaussian beam profile
- narrow spectrum
- efficient (10 - 70 %)

Functional elements

wavelength selective elements

tuning and mode control

- etalons
- gratings

pulsers

active / passive mode-locking and Q-switching

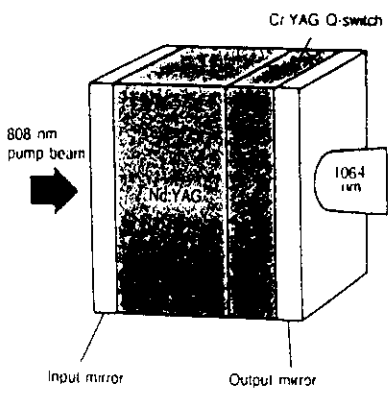
- doped crystals , Cr^{4+}, ...
- semiconductors, bulk, QWs

wavelength converters

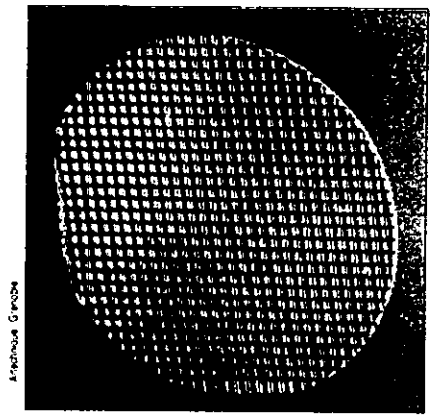
- frequency doubler
- optical parameric oscillator

Microchip lasers emit kilowatt peak pulses

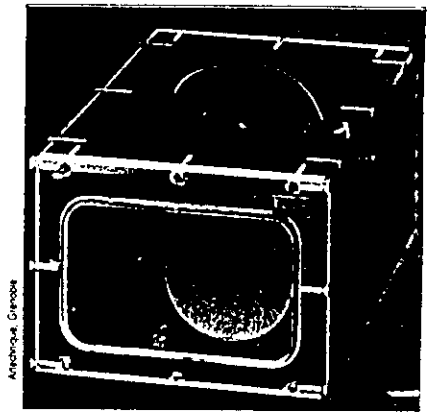
Industry needs small, tough lasers for tasks such as marking, metrology, gas detection and alignment. Simple new microchip devices are meeting the demand. **John Bell** reports.



French microchip laser with a Cr:YAG Q-switch.

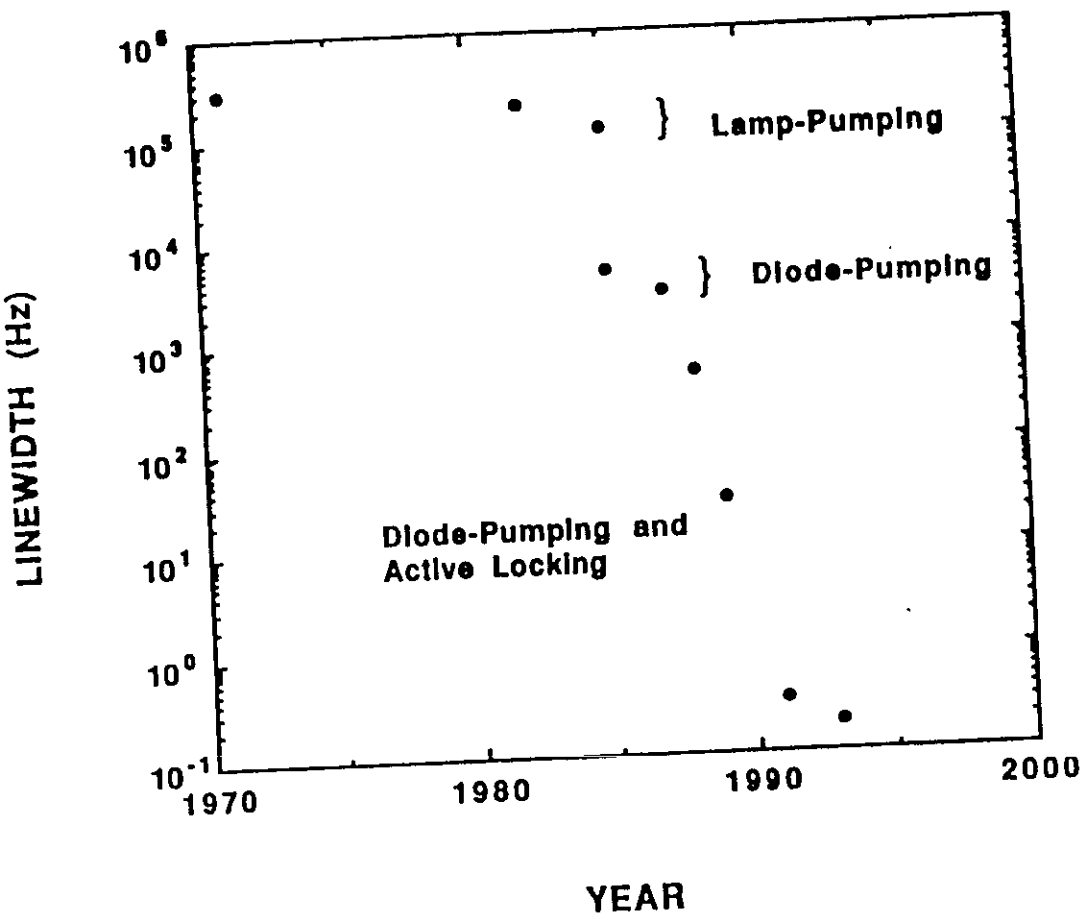


Lasers cut from a 1 inch Nd:YAG wafer.



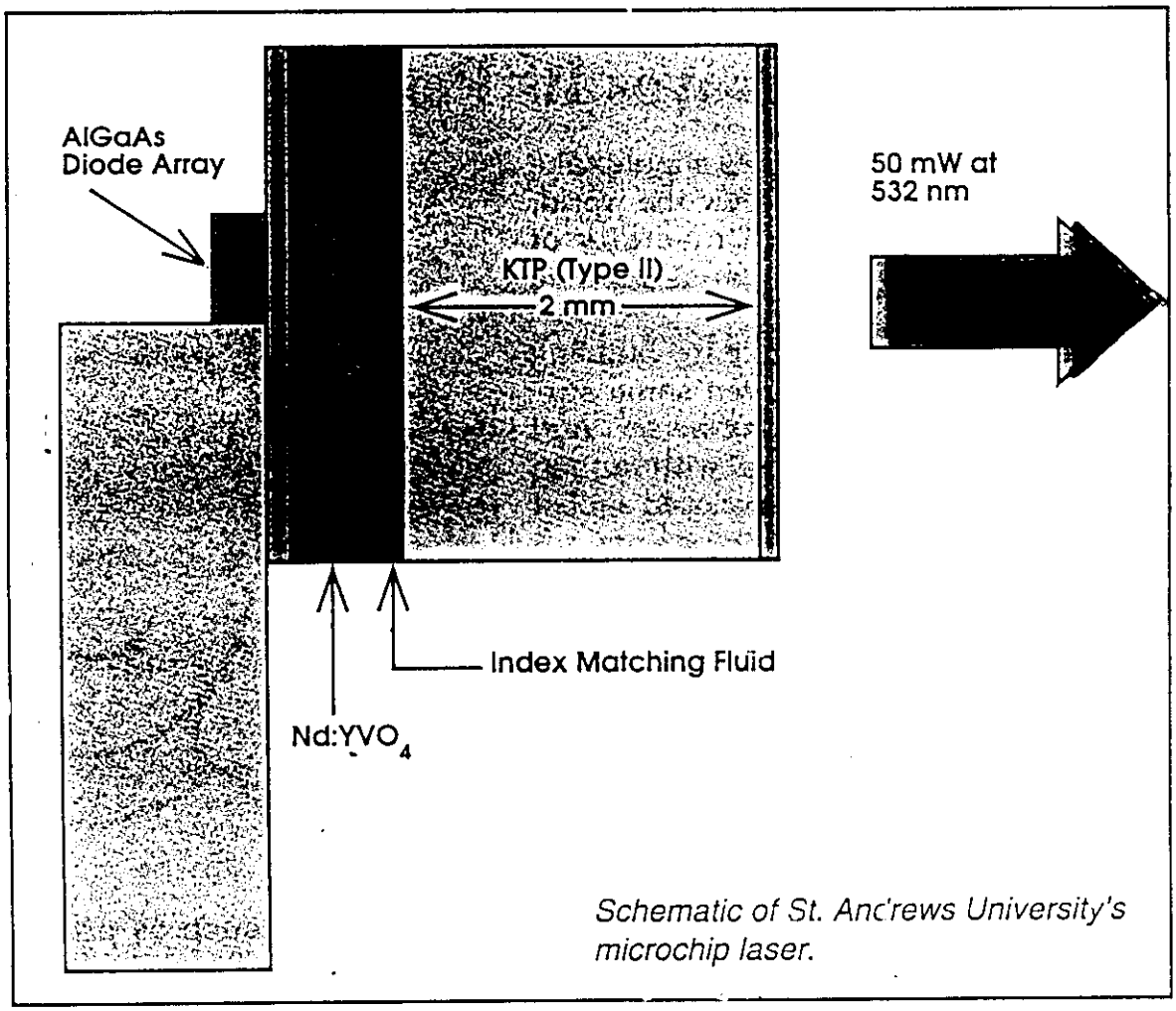
Rangefinder with infrared and green lasers.

Nd:YAG LINEWIDTH



T. Y. Fan

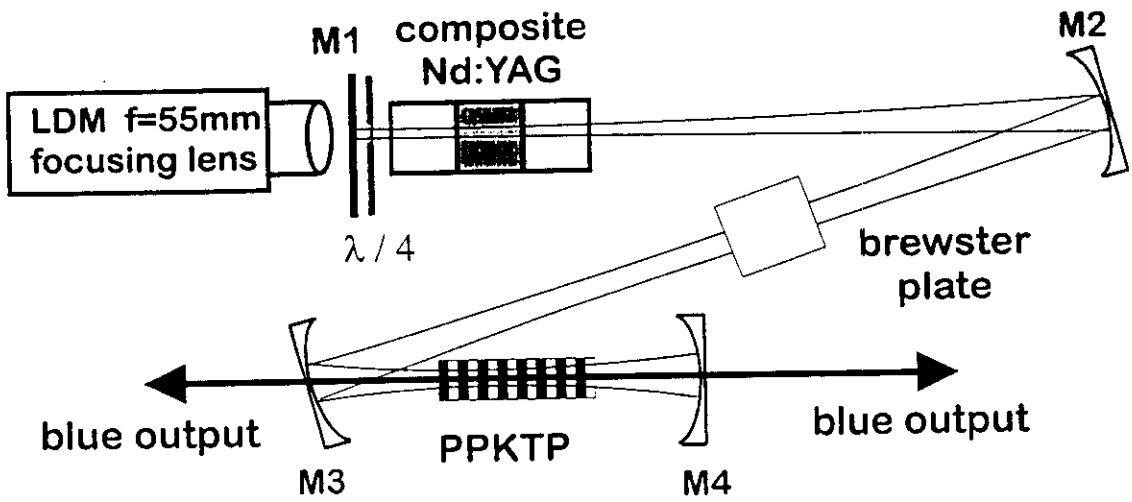
Doubled YVO Microchip Developed at St. Andrews



Schematic of St. Anc'rews University's microchip laser.

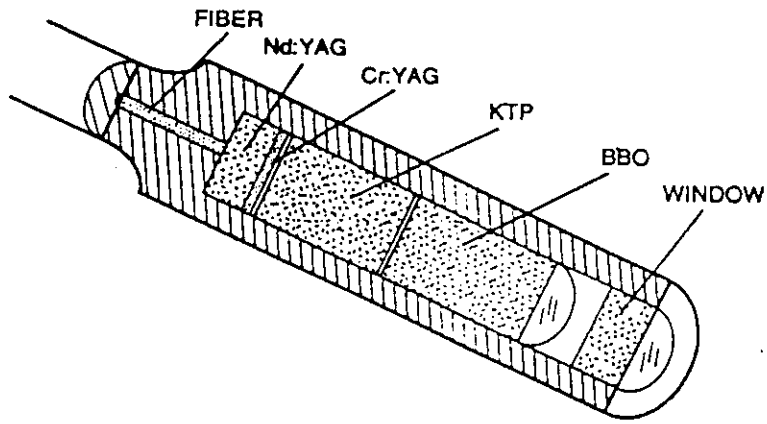
Generation of 740 mW of blue light by intracavity frequency doubling with a first-order quasi-phase-matched $KTiOPO_4$ crystal

Fig. 1
Optics Letters
Pierrou et al.



UV generation with passively Q-switched picosecond microchip lasers

J. J. Zayhowski, J. Ochoa, C. Dill III, *MIT Lincoln Laboratory, Lexington, Massachusetts 02173-9108*



CTuM2 Fig. 1. Illustration of the frequency-quadrupled passively Q-switched picosecond microchip laser.

By quadrupling the output of a passively-Q-switched microchip laser,[1] we have demonstrated 0.5-μJ UV pulses of 250-ps duration from a 3-cm-long × 1-cm-diameter package. The device, illustrated in Fig. 1, is pumped by a 1.2-W fiber-coupled diode laser and operates in a single-frequency, linearly polarized, diffraction-limited mode at pulse repetition rates up to 13 kHz over a temperature range of >70°C.

The passively-Q-switched laser consists of a 1-mm-long piece of 1.6-wt.% Nd^{3+}:YAG diffusion bonded to a 0.25-mm-long piece of Cr^{4+}:YAG with an absorption coefficient of 0.57 cm^{-1} at 1.064 μm. The pump-side face of the Nd:YAG is dielectrically coated to transmit the 808-nm pump light and to be highly reflective at 1.064 μm. The output face of the Cr:YAG is 85% reflecting at the oscillating frequency. The 440-ps, 7-μJ/pulse output of the laser is single frequency, linearly polarized, and diffraction limited, with a waist size of 50 μm and peak power of 14 kW. This output is frequency doubled with 42% efficiency in a 5-mm piece of KTP placed adjacent to the output face of the laser. A 5-mm-long BBO crystal placed adjacent to the KTP doubles the 532-nm radiation with 13% efficiency, resulting in 250-ps, 0.5-μJ, single-frequency, linearly polarized, diffraction-limited, 266-nm UV pulses with a peak power of 1.8 kW.

Diode-pumped Solid-state Lasers with functional intra-cavity elements

is a rapidly emerging area

They give

- improved performance
- easier operation
- new functions
- lower cost
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