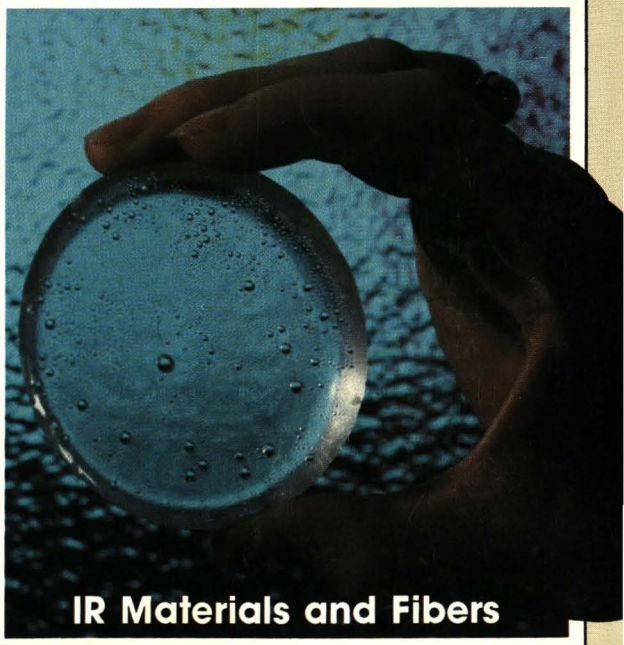
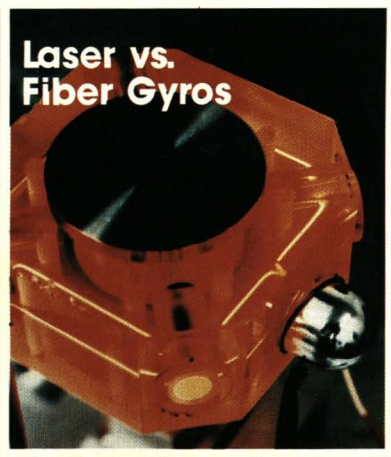
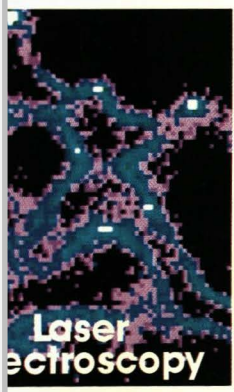


McGraw-Hill Chemistry Library December 1985

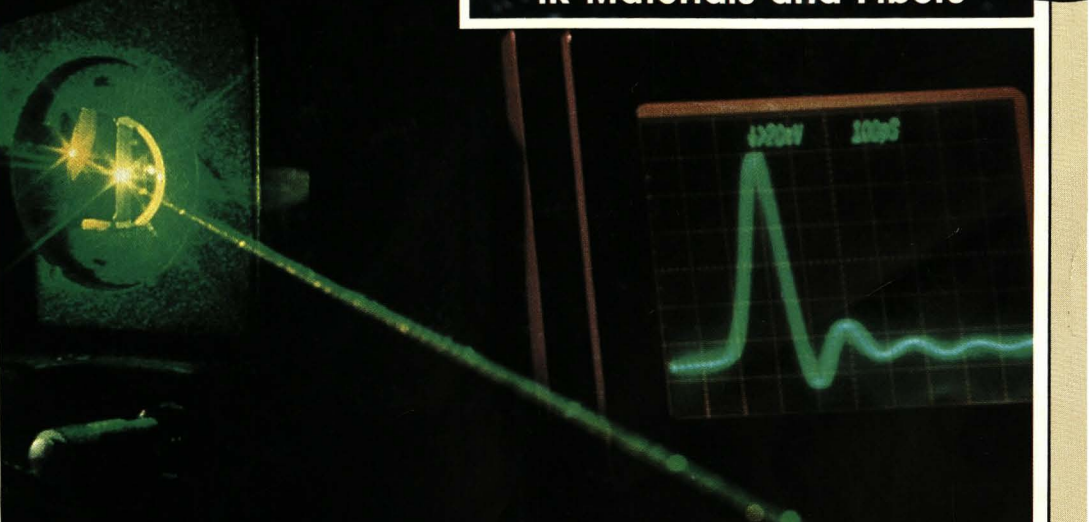
Full Publication

# LASER FOCUS

## MAGAZINE OF ELECTRO-OPTICS TECHNOLOGY



252P54272 120185 0021  
LIBRARY  
TUFTS UNIVERSITY  
ACQUISITIONS DEPT



DOCKET  
ALARM

Find authenticated court documents without watermarks at [docketalarm.com](http://docketalarm.com).

## FOCAL POINT

### COST CONSIDERATIONS FOR INDUSTRIAL EXCIMER LASERS

By GARY K. KLAUMINZER

As industrial applications for excimer lasers are developing, designers are beginning to address the issue of cost. This issue is complicated because there are no "industrial" excimer lasers on the market today, so no user or manufacturer can ac-

The editors recommend the detailed analysis in this article as a model for the discussion of cost issues. These issues, however, are never cut-and-dry. Readers should bear in mind that capital and component costs and reliability may be difficult to evaluate and will change as the technology advances. This will in turn affect the conclusions to be drawn.

curately predict the costs for a given application. But we can identify the major cost elements and give rough estimates based on output power and level of usage. In doing so we find that maintenance costs—labor and replacement parts—exceed capital costs for most excimer lasers, and that fuel gas costs are small by comparison. The following analysis covers lasers from 10- to 200-W average power, and includes capital, maintenance, and fuel gas costs for each per kilowatt-hour of operation.

#### Capital costs

The most visible cost for any laser is the initial cost to purchase. Figure 1 shows the cost per watt as a function of output power for a number of commercial excimer lasers designed for scientific applications. The 200-W laser does not exist yet, but

GARY K. KLAUMINZER is president of Questek, Inc., 44 Manning Road, Billerica, MA 01821.

the cost is extrapolated from the 100-W laser. The output power is for 248 nm (KrF); the same laser gives lower power at 193 nm (ArF), 308 nm (XeCl), and 351 nm (XeF), with the weakest about 50% that of KrF.

For the next generation of excimer lasers designed for industrial applications, the capital cost per watt should decrease as application-specific designs are produced in higher volume. A rough estimate of cost per watt for 1988 is shown by the dashed line.

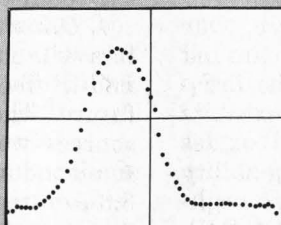
#### Maintenance cost

Excimer lasers require routine maintenance to change fuel gas, clean optics, if necessary, and otherwise check system performance. This analysis ignores such maintenance and focuses on the cost to replace major components in the laser which have "worn out." Each component is analyzed independently to determine a service interval, although in practice a preventive maintenance schedule will group

### Nd:YAG LASERS Pulsed and CW from Spectron

- Highly stable INVAR resonator.
- Pulse energies up to 850mJ at 1064nm.
- Repetition rates to 50Hz.
- Optional pulsed operation at 532, 355 and 266nm.
- CW power up to 50 watts.
- Q-switched pulse width ~10nSec.
- Dye laser system with conversion efficiency >30% of 532nm pump.
- Dye laser line width <0.1 cm<sup>-1</sup> available.
- Innovative ceramic reflectors provide extremely uniform pumping and a very high quality laser beam.
- Unique temperature stabilized, Brewster-angled Pockels cell.
- State-of-the-art, switched-mode power supplies.

### LASER BEAM PROFILE MONITOR from Delta Developments



- Pulsed or CW lasers.
- 60 element pyro-electric array.
- Element size: 0.375 x 2.7mm  
0.375 x 1mm (optional)
- Spectral range: 0.2 to 30 microns.
- NEP (per element): 15 nJoules.
- Dynamic range: 1.3 x 10<sup>4</sup>
- Calibrated power density.
- Complete with display monitor.
- Internal storage of 4 traces.

### PHOTON DRAG DETECTORS from Edinburgh Instruments and Rofin-Sinar Ltd.

- Ideal for pulsed CO<sub>2</sub> lasers.
- Fast response (~1nSec)
- Responsivity up to 500mV/MW, (unamplified.)
- High damage threshold (>25 MW/cm<sup>2</sup>)
- Improved 4-ring electrodes available for uniform sensitivity
- Detectors (absorbing) or monitors (>70% transmission) available
- Apertures from 2 to 25mm.
- Selection of amplifiers, x10, x100 or x1000.

Distributed exclusively in North America by:

**QEI**™

QUANTUM ELECTRONIC INSTRUMENTS, INC.