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Diode Array Alternative to Paint Removal Solid-State CW Laser

Brian Comaskey

December 1993

MASTER

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Advanced Applications
Laser and Environmental Programs

December 29, 1993

TO: Distribution

FROM: Brian Comaskey

SUBJECT: Diode array alternative to paint removal solid-state cw laser

The purpose of this memo is to highlight an alternative to the approach for cw laser paint removal as described in Nils Carlson's November 8, 1993 memo entitled "SERDP FY'94 Proposal for Laser Paint Removal System." The point to be made is that a direct diode design is feasible and can be far more competitive than a solid-state laser based system.

Through by-passing the use of a solid-state laser media, we immediately gain a factor of about five in system efficiency based on measured optical-to-optical efficiencies of our average power diode pumped lasers. This permits a massive reduction in system cooling requirements. It should be noted that cooling system size was the greatest concern voiced by Gordon McFadden at Hobart Lasers with regards to his Nd:YAG laser systems operated in field applications. Furthermore, with direct diode use far fewer diode packages will be needed to deliver a given amount of wattage on the target. This will largely eliminate the intimidating sticker shock and shorten (proportionally by the diode count) the required run-to-fail times demanded of the system.

A simple Beam-3 based doublet cylinder lens exercise is illustrated in the attached figure. It gives a 10.8 aperture reduction in the stacking dimension of the 20 package, 2 cm high diode stack. Use of micro-lenses are assumed, and Ray Beach's figures of merit for them are used (80% transmission, ± 20 mr full energy stack angle of divergence--this latter figure may be reduced in the future with more developments in stacking technique). For this memo, no concern is given to the traditionally slow divergence dimension along the length of the diode bars, as it may be ignored in short optical systems and can be corrected in long systems with condensing optics. The line focus is taken to be 2 cm long in this exercise. For the lowest power performance in cw packages considered in Nils' memo (40 watts/package), we obtain 3.5 kW/cm², while for the highest performance considered (150 watts) we obtain 13

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kW. These figures give us a performance range well within to beyond the 2 to 10 kW/cm² suggested for cw paint stripping.

Unlike the fiber-coupled solid-state laser scheme, the direct diode head would have to be integral with the light condensing/fume vacuuming hardware at the working end. This would require a DC power line and a cooling line in place of an armored fiber-optic cable. However, this would not be a significant increase in system cable bulkiness (particularly compared to the vacuum hose) as we are supporting only about 20 diode packages (2 volts and 3 cc/sec of water per package). The diode output head would not be any larger as both systems sizes would be determined by condensing optics and vacuum pick up, and perhaps air/oxygen supply hardware.

To summarize, a purely diode based design for paint stripping would be the most compact and efficient deployable system. It emphasizes our most basic strengths and competitive advantages. This development effort would encourage diode and diode package performance development in directions we must go anyway. A success in this field would highlight our distinctive diode technologies to the commercial markets.

Attach.

Distribution:
Georg Albrecht
Ray Beach
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**DATE
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6/30/94

END