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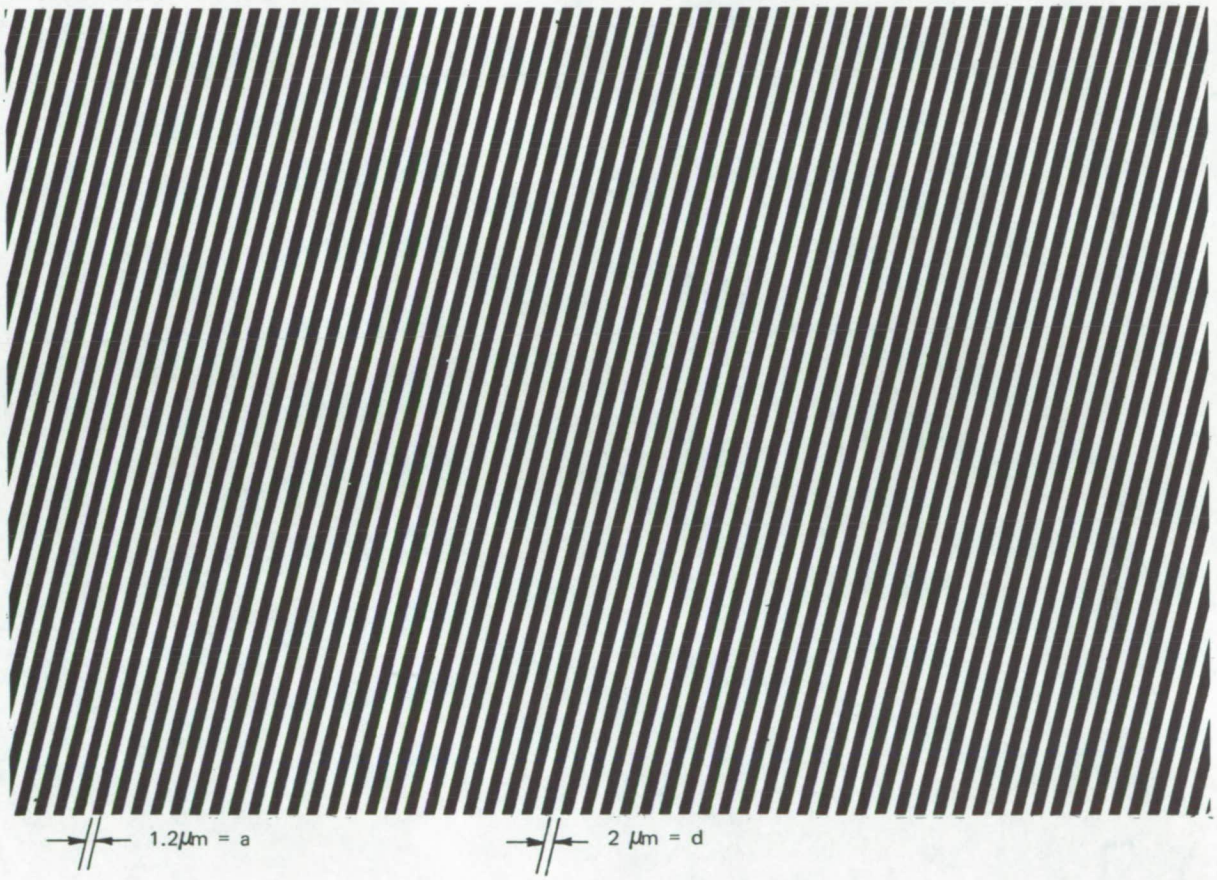
NASA TECH BRIEF

Goddard Space Flight Center

Efficient Wire-Grid Duplexer-Polarizer for CO_2 Lasers



The problem:

The design of a CO_2 laser communication system has required an efficient 10.6-μm duplexer to separate two orthogonally polarized laser beams arriving from opposite directions. Of all the existing wire-grid polarizers examined, none were useful for transmission of the 10-μm radiation.

The solution:

An efficient 10-μm wire-grid, chromium duplexer-polarizer was developed by use of the holographic and chemical-etching techniques.

How it's done:

Chormium wire-grid polarizers are made by exposure of photo-resist films of thicknesses varying from 0.2 to 1 μm with two collimated Cd-He laser beams having 5-cm diameter and producing a 441.6-nm wavelength. The photoresist film is spin-coated on a thin silicon

(continued overleaf)

substrate, 0.2 ± 0.02 mm in thickness and 2.5 cm in diameter. For a film thickness of 0.5 μm, a total energy of a few joules is required from each laser beam to reach the proper exposure level.

The exposure completed, a thin layer of 50.0 nm of chromium film is deposited over the photoresist film grating at an oblique angle of 10°. The uncoated portion of photoresist film is then stripped away to produce a chromium wire-grid polarizer with 500 lines/mm over a 2.5-cm diameter surface. The resulting wires are homogeneously spaced at 2 μm with wire width of 1.2 μm, as shown in the figure.

Performance results of the duplexer-polarizer show the measured peak reflection of the parallel component at 85%. The maximum transmission through the silicon wafer is 24%. To reduce both the surface and absorption losses, a germanium substrate coated with dielectric films should be used.

Note:

Requests for further information may be directed to:
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Reference: TSP72-10440

Patent status:

No patent action is contemplated by NASA.

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