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(71) Applicant (for all designated States except US): **ELECTRO SCIENTIFIC INDUSTRIES, INC.** [US/US];  
13900 N.W. Science Park Drive, Portland, OR 97229-5497 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **BAIRD, Brian, W.** [US/US]; 18250 S. Clark Lane, Oregon City, OR 97045 (US). **WOLFE, Michael, J.** [US/US]; 7400 S.W. Barnes Rd. #223, Portland, OR 97225 (US). **HARRIS, Richard, J.** [US/US]; 16155 N.W. Canterwood Way,

Portland, OR 97229 (US). **FAHEY, Kevin, P.** [US/US]; 2715 S.W. Bucharest Ct, Portland, OR 97225 (US). **ZOU, Lain-Cheng** [US/US]; 5801 S.W. Sheridan Ct, Portland, OR 97221 (US). **MCNEIL, Thomas, R.** [US/US]; 1630 N.W. Eastbrook Ct., Beaverton, OR 97006 (US).

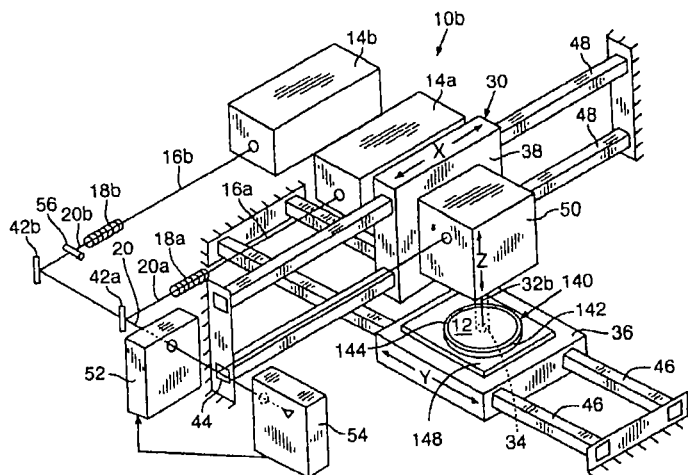
(74) Agent: **LEVINE, Michael, L.**; Stoel Rives LLP, 900 S.W. Fifth Avenue, Suite 2600, Portland, OR 97204-1268 (US).

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(54) Title: ULTRAVIOLET LASER ABLATIVE PATTERNING OF MICROSTRUCTURES IN SEMICONDUCTORS



\*ACTION\*

(57) Abstract: Patterns with feature sizes of less than 50 microns are rapidly formed directly in semiconductors, particularly silicon, using ultraviolet laser ablation. These patterns include very high aspect ratio cylindrical through-hole openings for integrated circuit connections; singulation of processed die contained on semiconductor wafers; and microtab cutting to separate microcircuit workpieces from a parent semiconductor wafer. Laser output pulses (32) from a diode-pumped, Q-switched frequency-tripled Nd:YAG, Nd:YVO<sub>4</sub>, or Nd:YLF is directed to the workpiece (12) with high speed precision using a compound beam positioner. The optical system produces a Gaussian spot size, or top hat beam profile, of about 10 microns. The pulse energy used for high-speed ablative processing of silicon using this focused spot size is greater than 200  $\mu$ J per pulse at PRFs greater than 5 kHz and preferably above 15 kHz. The laser pulsedwidth measured at the full width half-maximum points is preferably less than 80 ns.

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