LASER PROCESSING APPARATUS INCLUDING LASER SENSOR SYSTEM AND METHODS OF MEASUREMENT OF BEAM CHARACTERISTICS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a national phase entry of Patent Cooperation Treaty Patent Application No. PCT/US2023/018938, filed on April 8, 2023, entitled "LASER PROCESSING APPARATUS INCLUDING LASER SENSOR SYSTEM AND METHODS OF MEASUREMENT OF BEAM CHARACTERISTICS", which claims priority to U.S. Provisional Patent Application No. 63/348,165, filed June 2, 2022, the contents of which are incorporated by reference in their entirety herein.

TECHNICAL FIELD

Embodiments described herein relate generally to laser-processing apparatuses and, more particularly, to laser sensor systems, the components thereof, and techniques for operating the same, in order to process a workpiece.

BACKGROUND

Laser-processing systems or apparatus are used in a wide variety of applications, including printed circuit board (PCB) machining, additive manufacturing, and the like. To process PCBs, precise control of ablation of the PCB materials (e.g., metals, insulators, used in forming vias, etc.) is required when, for example, laser-processing is used to form holes or vias therein. Accurate and repeatable measurements of the power or energy of the processing laser beam is important for controlling ablation processes used to form these holes or vias. Laser sensor systems required for these precise measurements can be complex, expensive, and bulky. As such, there is a need for a laser sensor system that provides consistent and precise results with low system complexity and cost. The embodiments discussed herein were developed in recognition of these and other problems discovered by the inventors.

FIG. 1 illustrates a laser sensor system 30. The laser sensor system 30 include mirrors 32a, 32b, 34a, 34b, and photodetectors 36a and 36b, respectively. The mirrors 32a and 32b are provided to direct light propagating along beam paths 14a and 14b coming from the first positioner 106 to mirrors 34a and 34b. Mirrors 32a and 32b are provided as turn mirrors and the mirrors 34a and 34b are provided as partially-transmissive mirrors configured to reflect a majority of light in the incident beam of laser energy and transmit a small amount of the light to the detector 36a. The portions of the beam of laser energy not transmitted by the partially-transmissive mirrors 34a and 34b are directed to scan heads 120a and 120b, respectively. The detector 36a is arranged to receive light transmitted by partially-transmissive mirror 34a and the detector 36b is arranged to receive light transmitted by partially-transmissive mirror 34b. The detectors 36a and 36b are configured to sense or measure laser energy or power transmitted thereto, and generate sensor data based on the sensing or measurement.