Kawasaki High-speed Laser Scanning System – Using differentiation technology to boost the

Preface

In recent years, laser scanning systems have come to be used in thin-film circuit forming for thin-film solar cells, touch panels and so forth in pursuit of improvements to productivity. Additionally, laser scanning has begun to see applications in areas such as 3D printing and laser coating, and the scope of applications is expected to expand even further in the future.

1 System configuration

Figure 1 depicts a simulated system configuration, consisting of a workpiece loading unit, a laser scanning unit and a workpiece unloading unit. Although Fig. 1 places the laser scanning unit below the workpiece, it is also possible to position this section above the workpiece.

2 Advantages

Our system offers the following advantages, which enable a wide range of high-quality laser machining operations and lead to improved productivity.

(1) Workpiece pass-through system with ultra-high-speed scanning

Through the use of ultra-high-speed laser scanning (10,000-20,000 mm/sec.), our system achieves continuous passage of workpieces with simultaneous machining operations. Furthermore, the system's physical footprint is extremely compact, facilitating easy integration into existing production lines.

(2) Wide scanning area and vertical laser-beam projection

Figure 2 compares a standard galvano scanner with our system. The galvano scanner has a small scanning area, and the beam profile becomes warped and less uniform closer to the edges of this scanning area, making it difficult to achieve consistent machining results over a wide area. In contrast, the Kawasaki system has a large scanning area (up to 1,400 mm wide), and because the laser is always projected vertically onto the workpiece it is possible to achieve uniform and consistent-quality laser machining results.

Until now, it has only been possible to handle small workpieces (localized machining) using laser machining processes. However, with our system it is now possible to handle large workpieces (wide-area machining).

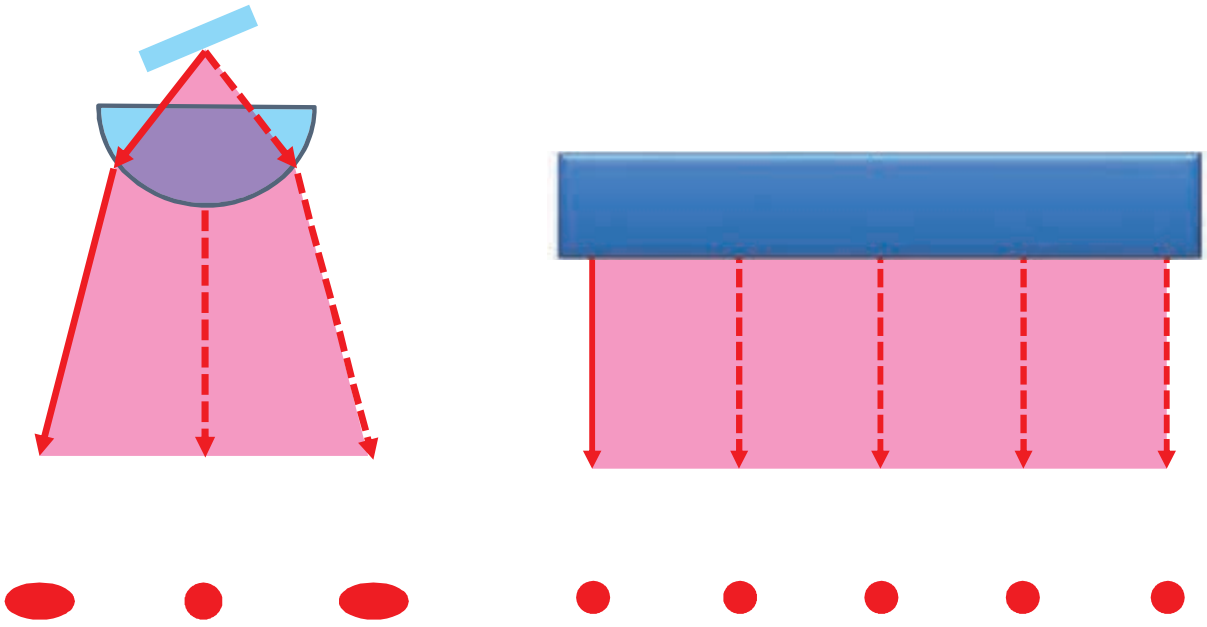
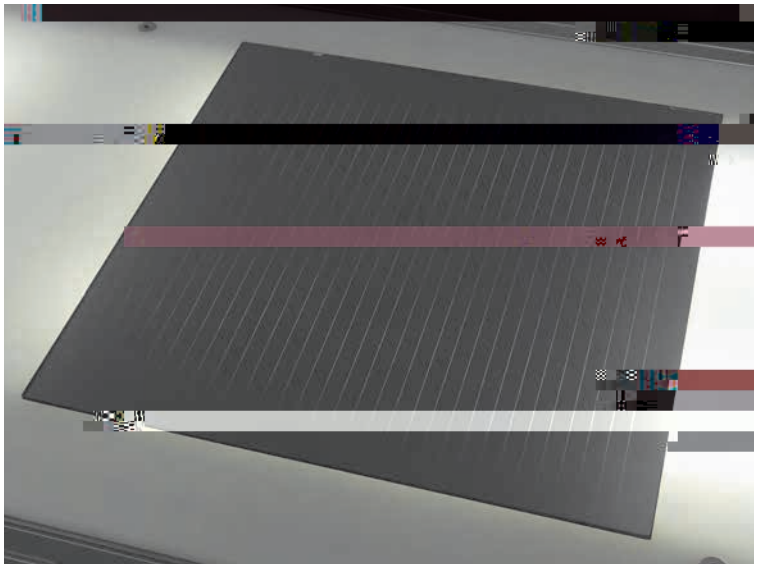


Fig. 2 Comparison with galvanometer scanner

(3) Uniform-width line cutting

Example machining results are shown in Fig. 3(a). The workpiece is a thin-film solar cell substrate: laser cutting has been carried out at 9 mm intervals on a molybdenum (Mo) thin film atop a glass panel. A magnified image of a section machined using our system can be seen in Fig. 3(b), and a magnified image of a competitor company's machined section is shown in Fig. 3(c) for comparison. In contrast to the non-uniform results produced by the competitor's system, Kawasaki's system achieves consistent, uniform-width machining, and does so at ultra-high machining speeds 50 times that of the competitor.



(a) Machining example: workpiece (after machining)

Table 1 Main specifications

External form	External dimensions (mm)	L 3,500 × W2,300 × H1,500
	Weight (t)	Approx. 4
Compatible workpieces	Dimensions (mm)	Between 300 × 300 and 1,400 × 1,100
	Board / plate thickness (mm)	1–5
	Additional details	Please consult with us regarding system configurations for use with workpieces that fall outside the above dimensional limits
Laser equipment	Type	YVO4 THG, SHG pulse laser
	Output / wavelength (W / nm)	14 / 355, 14 / 532
	Beam direction	From directly below conveyor surface to above
Equipment specifications	Scanning speed (mm / sec.)	Max. 20,000
	Scanning range (mm)	Max. 1,400
	Workpiece feed speed (mm / sec.)	Max. 400
	Feed stroke (mm)	Max. 2,000

3 Demonstration system

We have installed a system for demonstration purposes in our company facilities to respond to requests for sample machining tests. Main specifications of the demonstration equipment are outlined in Table 1.

4 Various fields of application

The system's laser equipment and optical components can be customized to meet user requirements, enabling the use of our product in the following types of applications.

① Circuit patterning: circuit forming (via thin-film cutting) for thin-film solar cell substrates, touch panels, etc.
② Surface modification/treatment: laser hardening and laser annealing (e.g., melt crystallization of amorphous silicon thin films, grain boundary formation in grain-oriented magnetic steel sheets for improved product quality, etc.)
③ Optical fabrication including 3D printing and UV curing of resins
④ Laser coating/cladding (padding)
⑤ Laser cleaning and laser stripping (of layers)
⑥ Laser exposure
⑦ Laser deposition
⑧ Laser cutting and laser beam welding
⑨ Inspection and measurement

Postscript

In the future, we hope to develop applications in new fields by responding to user requests for sample machining processes while providing higher quality and productivity in laser-based processes in order to assist in the development of new products.

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