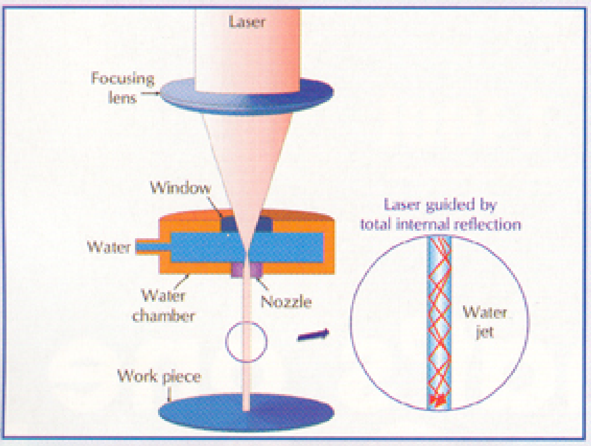
Hybrids for manufacturers

By Alan Richter, Managing Editor

This month, CUTTING TOOL ENGINEERING covers a technology that uses a waterjet to guide a laser for ablating workpieces, and a "smart machining" system that optimizes NC programs and monitors the condition of the cutting tool.

Guided by water

Manufacturers have long employed waterjets and lasers to cut a variety of materials—but always separately. A hybrid technology from Synova SA, Switzerland, combines the two. The Laser-Microjet uses a low-pressure waterjet emitted from a diamond or sapphire nozzle to guide a laser beam. The 25µm- to 100µm-dia. waterjet stream contains no abrasive; the laser ablates, or melts, the workpiece material without creating burrs or leaving deposits.



Because the processing time increases as the workpiece thickness increases, the Laser-Microjet waterjet-guided laser is most efficient when cutting workpieces from 30µm to 300µm thick. However, the laser can cut workpieces up to 3mm thick.

When leaving the nozzle, the laser beam is guided inside the waterjet—a liquid fiber of variable length—by total internal reflection at the interface between the air and water. The laser is reflected and transmitted along the waterjet's length similar to how a conventional glass fiber works. The direction and intensity of the resulting light rays depend on the angle of incidence. An angle of incidence from 48.7° to 90° reflects all light at the water/air interface.

Once the laser beam reaches the workpiece surface, the material absorbs it and melts. The absorbed laser energy generates plasma on the surface, separating the water and workpiece. At the end of the laser pulse, the plasma disappears and only the waterjet contacts the surface. The waterjet travels at up to 300 m/sec. to quickly remove molten debris. Before the next pulse is emitted, the waterjet removes any heat that might enter the material, thereby preventing microcracks and structural damage.

The application dictates the appropriate water pressure, which varies from 1,000 to 7,250 psi. The force acting on the workpiece is smaller than the force exerted by the cutting gas of conventional lasers.

The Laser-Microjet's wattage is also less than a conventional laser. The average power is 6w to 10w when the hybrid technology cuts with a UV laser and 40w to 200w when using an infrared or green laser.

Unlike a conventionally focused laser beam, which has a limited working distance of a few millimeters because of beam divergence, Synova says the Laser-Microjet's parallel laser beam can cut at a distance of up to 100mm. In addition, the laser can cut multilayer materials because the waterjet is able to guide the beam through each layer. There is no limit to the number of layers, but the thickness of the multilayer workpiece cannot exceed the beam's cutting distance.

The technology can be adapted for edge grinding, drilling, slotting, grooving, marking, scribing, wafer dicing and stencil cutting. Synova reports that the waterjet-guided laser can be used for making automotive parts, such as catalytic converters and injection nozzles, and medical parts, such as stents and implants.

In addition to cutting silicon, ceramic, metal sheets and compound semiconductor materials, the Laser-Microjet can cut CBN and diamond cutting tools.

Open for machining

VulcanCraft LLC is developing a machining system that combines an NC verification model with online spindle-power data to monitor tool condition.

Donald Esterling, president of the Carrboro, N.C., company, explained that spindle-power data is used to determine cutting tool forces. A self-calibrating system then compares real-time tool forces with expected, sharp-tool forces to monitor tool wear and detect tool faults. The calibration, integrated with an NC verification system, automatically adjusts for different cutting tools, workpiece materials and cutting conditions.

"We do online calibration to determine sharp-tool model parameters, which then predicts what the spindle power

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