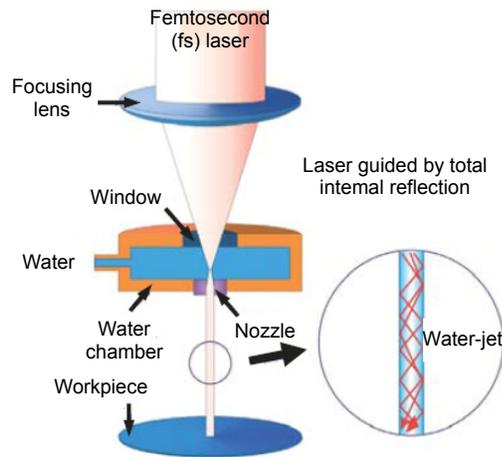


# Current status of water-jet guided laser cutting technology

Boyu Sun, Hongchao Qiao\*, Jibin Zhao, Ying Lu and Yuebin Guo

Equipment Manufacturing Technology Department, Shenyang Institute of Automation,  
Chinese Academy of Sciences, Shenyang 110016, China



The basic principle of water-jet guided laser cutting.

**Abstract:** In the field of parts cutting, compared with the traditional mechanical cutting and high-pressure water jet cutting, laser cutting has significant superiorities in processing efficiency, precision and environmental protection. However, the thermal damage on the material caused by laser cutting will affect the performance and working life of the parts which limits the development of laser cutting. In order to solve this problem, water-jet guided laser cutting technology is invented. Water-jet guided laser cutting technology is a composite processing method which uses the water jet to guide the laser beam for cutting the workpiece. For the difference between the refractive indexes of water and air, when the laser beam passes through the water and air interface at a certain angle, the laser will be totally reflected without refraction if the incident angle is less than the total reflection critical angle. This phenomenon can be utilized to propagate the laser in the water jet and guide it to the machined surface for cutting. The advantages of this technology are small heat affected zone, high precision, no pollution and so on. Because of the superiorities of the water-jet guided laser cutting technology, the domestic and international researchers are increasingly interested in the relevant principles and key technology of the water-jet guided laser cutting. Their researches provided theoretical basis of the water-jet guided laser which promotes its development and application. The domestic and international research progress of water-jet guided laser cutting is reviewed from two aspects: theory and process. For example, Li Ling studied the water-jet guided laser technology by the experiment, finding the relationship about the laser energy attenuation and water jet stability. Besides, the cutting parameters about pulse energy, processing speed, and working distance for processing silicon were also optimized. The processed silicon wafer has little burrs, cracks, heat affected zone, and the surface quality is good. At last, the development status of water-jet guided laser equipment is summarized. The future development direction of the water-jet guided laser cutting is larger energy and finer water jet. But at the current stage of research, there are many technical difficulties in terms of nozzle orifice manufacture, coupling control system and process research. In the future, theoretical and experimental researches on water-jet guided laser cutting should be studied to accelerate the development of equipment and reduce the gap between the domestic and abroad.

**Keywords:** water-jet guided laser; heat affected zone; coupling technology; nozzle orifice

**Citation:** Sun Boyu, Qiao Hongchao, Zhao Jibin, *et al.* Current status of water-jet guided laser cutting technology[J]. *Opto-Electronic Engineering*, 2017, **44**(11): 1039–1044.

See page 1039 for full paper.