Precision laser/robot cutting

Developments in laser technology and fiberoptic beam delivery have helped the Nd:YAG laser win a reputation as a viable, economic alternative in some cutting applications.

Tim Morris

The application of robotic laser cutting systems has grown dramatically in recent years. This can be attributed to several key factors:

- Development of fiberoptic beam delivery for Nd:YAG lasers
- General acceptance of laser processing in industrial environments
- Introduction of higher-powered Nd:YAG lasers increasing the cutting speeds and thickness range
- Advancements in peripheral equipment for cutting applications
- Realization of the economic benefits of flexible automation for small batch processing

Precision cutting as discussed here is defined as cutting on a finished product that requires no further processing on the cut edge to meet its intended function. These precision cuts can range from small shapes to large three-dimensional contour trimming operations. Robotic Nd:YAG laser cutting can provide minimum repeatabilities of ± 0.010 in. and, in some cases, minimum repeatabilities as good as ± 0.002 in. can be achieved. These cuts are typically dross free with side wall bevel angles of less than one degree.

This process has attained a reputation of being a reliable and safe industrial method as more and more lasers have been incorporated in the manufacturing environment. As industry becomes more educated and understands the easily manageable safety requirements, the process will become increasingly accepted.

Although the vast majority of industrial laser cutting applications utilize CO_2 lasers, the Nd:YAG laser has virtually taken over the robotic cutting market. The fiberoptic beam delivery of Nd:YAG lasers is much more user friendly when compared to maintaining alignment in the hard optic beam delivery systems that are required for CO_2 lasers. This factor, in addition to the recent increase in available power levels, makes the Nd:YAG laser the laser of choice. It should be noted that CO_2 lasers are still an attractive method for some nonmetallic cutting applications (such as textiles and plastics), where the longer CO_2 wavelength is more efficient or where power levels above 3 kW are required.

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Process selection criteria

To aid in determining if an application is a viable candidate for robotic Nd:YAG laser processing the following review of the robotic Nd:YAG laser process and how it compares to competing technologies is presented. A brief review of competing processes highlights where robotic Nd:YAG laser processing excels for precision cutting applications. As stated, CO_2 laser processing will not be discussed here.

In the context of precision metal cutting, two other processes can be considered: conventional (air and oxygen) plasma and precision plasma. Conventional plasma cutting is typically associated with two-dimensional cutting of sheet materials from 0.25 in. up to 3.0 in. thick where fine detail is not required. The relatively new precision plasma process fills the gap between conventional plasma and lasers. This process offers higher power densities than conventional plasma resulting in less heat input, allowing finer