Advantages of Laser Marking

Light has much relationship with nature matters and living species, since light has a very wide range in its wavelength spectrum (near zero to about 100 mm) and has been underlying in almost every activities of life. Since 1960, when the first laser was operated, extensive research and development have been undertaken leading to a rapid growth in laser types, output power and scope of applications. The reason for the rapid development in laser technology lies in five distinct properties of the laser beam: monochromaticity, coherence, good directionality, high brightness, and short pulse duration. Now lasers are widely used in almost every field of industry, agriculture, research and development, military, education, and daily-used appliance. For example, CO_2 lasers have been finding wide use in almost every aspects of laser material processing such as cutting, welding, cladding, and heat treatment. It is currently the most powerful material processing laser with commercial laser being offered up to 45 kW. Nd:YAG lasers are being widely used in laser drilling, marking, and cutting. Diode-pumped solid state lasers have been finding more applications in semiconductor fabrication/repair, micro-material processing, medical diagnostics because of their all solid state reliability, high efficiency, and long life time. Since the short wavelengths of excimer lasers permit both fine spatial resolution and cold ablative processing, excimer lasers have developed from physicists' "toys" to powerful tools in material processing since their initial demonstration 20 years ago. It is reported that the world commercial sales of diode lasers and nondiode lasers are 84,370,408 and 361,581 units respectively, reaching US$264.5 and US$700.5 millions respectively in 1994.

Product laser marking is one of the most common industrial applications of lasers. The laser marking systems using different lasers and optical delivery systems may be used to mark an almost endless list of materials including metals, plastics, ceramics, glass, wood and leather as well as painted surfaces and photographic emulsions.

As we know, information such as part number, operating instructions, date of manufacture, logos, etc., is needed for typical quality control monitoring as well as consumer protection. A wide variety of marking and labelling methods has been developed. Examples include pen or pencil writing, press labelling, and ink-stamp marking. Each method has its own advantages and disadvantages. Label markings, for instance, are generally not permanent. Even through ink markings can produce very legible and permanent writings, the method involves many imprecise and time-consuming steps. Furthermore, this method is not satisfactory for marking minute objects or large objects with very small print. In addition, there are complications associated with equipment maintenance and control of the print quality.

Laser marking most commonly takes the form of an alphanumeric code imprinted on the surface of the product to indicate the date of manufacture, best-before, serial number etc. Therefore, it is a surface process. The marking processes include one or a combination of the following processes:

(1) black carbonisation;
(2) bleaching or changing the colour of a colorant in the material;
(3) physical modification of the surface finish;
(4) scribing a shallow groove into the material by vaporisation;
(5) highly-controlled modification of the surface by melting.

Laser marking is superior in quality and flexibility to traditional marking techniques; it leads itself to automation and integrated production techniques. The common advantages of all laser marking techniques are

(1) permanent, high quality marks;
(2) high efficiency and low operation cost;
(3) good accessibility, even to irregular surface;

(4) non-contact marking and no special working environmental needed;
(5) easy to automate and integrate (direct writing of patterns can established using computer-controlled movement of the beam or sample);
(6) precise beam positioning and a beam highly localised energy transfer to the workpiece (a narrow damage zone);
(7) high reproducibility, high speed and throughput; and
(8) contamination - free.