Book review

Laser Processing of Engineering Materials by John C. Ion

2005, Oxford, Butterworth Heinemann, ISBN 0-7506-6079-1, 576 pp., £40/€44·95/$59·95

A laser is a device for the creation, amplification and transmission of a narrow, coherent beam of light. In a brilliant opener, the author gives an enticing story about the applications of lasers. Who would have thought that the humble shaving-razor relies on tens of laser spot-welds per system? Lasers are now household items, e.g. compact disc players and disc drives; consumer items such as jewellery and cars have touched lasers at some stage in their manufacture. We routinely use printers without thinking about the adjective 'laser'.

Roughly a third of the book lays the foundations: there is an introduction to the physics of lasers, the engineering and optics needed to make useful lasers, the implementation of laser systems in industry, an elementary discussion of materials together with a nice description of their interactions with laser light. There are the inevitable property maps and processing diagrams that identify domains of laser parameters that are appropriate for cutting, cladding and other functions.

Most engineers know that lasers can be regarded as heat sources that when directed at materials cause physical changes such as melting, vaporisation or solid-state transformations. But the interaction of a laser with a substrate can apparently be of a kind that leaves the temperature unchanged and yet leads to energy transfer, in the so-called athermal process. A good example is the laser printer, in which light is used to change the local electrical field on a drum, in such as way as to facilitate the precise printing of characters. It is details like these that make this book fascinating to study.

The book is not a homily to lasers – both the limitations and advantages are I think, fairly covered; this is a refreshing approach that avoids the spin associated with much of the new materials science we see today. A typical example is the chapter on surface hardening; there are clear explanations on where it would be appropriate to use lasers instead of conventional methods. Similarly, the application of lasers to cut complicated shapes or specialised components is well established, but is frequently not as productive as mechanical punching. Keyhole welding is identified as an area that has not reached its full potential, partly because knowledge about the process has not been widely disseminated but also because of the lack of agreed industrial standards.

There is a wonderful chapter on laser marking, which is the only way an ordinary consumer can identify the difference between an artificial and a natural diamond in circumstances where irrational choices are made, based on sentiment rather than sense.

Much effort has also been devoted to treat a large variety of materials in the context of laser processing; metals in construction, cladding, biomedical, and fabrication industries; polymers, ceramics, composites and glasses feature, as do electronic applications.

John Ion's book is a uniformly excellent treatise on the laser processing of materials. His deep knowledge of the subject has led to a text which is easy to follow and yet is a state-of-the-art assessment which will be exploited by researchers. John is a teacher as well as a leading scientist in all things laser. It is not surprising that the book includes exercises at the end of each chapter (solutions available free to teachers), a useful glossary, and like all good PhD theses, a final chapter on the future.

I am delighted that this book has been written. It is a work of scholarship which will undoubtedly serve us well for the decades to come.

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