# The importance of laser beam intensity profile and shape in the optimisation of laser processing

**Neal Croxford**
*Technical Director*
*Needham Laser Technologies*
*Waymills Industrial Estate*
*Whitchurch*
*SY13 1TT*

*neal.croxford@needham.group*

The ever-increasing power and beam quality of fibre lasers and fibre coupled direct diode lasers continues to broaden the range of laser processing applications and improve the quality and efficiency of existing applications. However, the ever smaller spot sizes have, if anything, highlighted the importance of tailoring the spot size, shape and intensity profile to the application to achieve the best quality and efficiency.

A diffraction limited Gaussian spot may be good for drilling lots of small round holes but presents many issues when processing large areas especially if the process has a small tolerance to the intensity of the beam. Some processes have a minimum activation intensity which is only twenty to thirty percent lower than the intensity which will cause burning or other undesirable effects. In these cases only the central ten percent of the power in a diffraction limited Gaussian beam is being used in the process, the rest is just heating the part without producing any useful effect. Couple this with the fact that a round spot has to be overlapped to achieve complete coverage of an area and the power being used by the actual process can be as low as six percent.

The intensity profile of the spot can be manipulated by a number of methods such as conventional and diffractive optics and recently the availability of non-circular fibre optics capable of handling over a kiloWatt. Combining shaped fibres with conventional optics enables the production of spots with even intensities in a range of shapes, massively improving the efficiency of some processes and enabling processes that would otherwise be impossible.

The applications are diverse from producing long line welds without the need to scan the beam, soldering whole ICs in one hit and the efficient even surface treatment of surfaces.