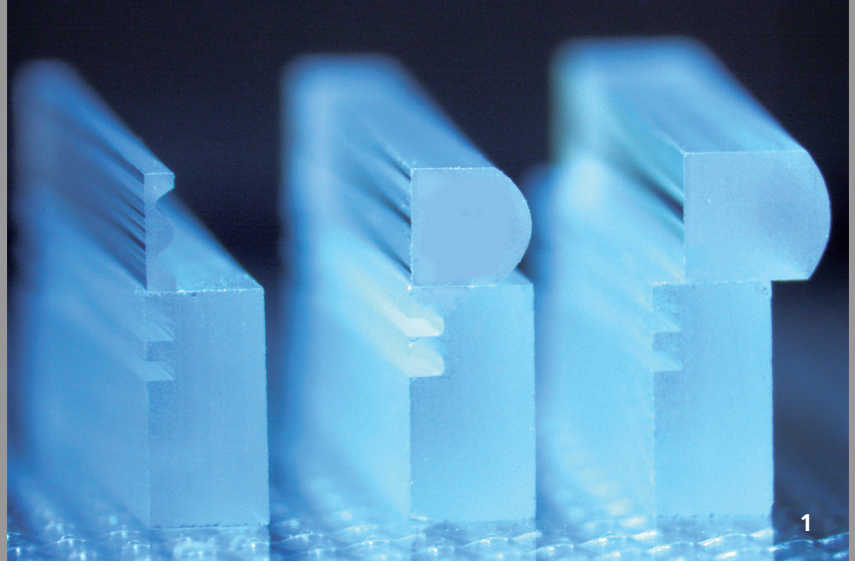

ALGORITHMS FOR THE AUTOMATIC ALIGNMENT OF MICRO-OPTICAL COMPONENTS

Task

The vast majority of manufacturing processes in the production chain for high-powered diode lasers are fully or partially automated, with alignment of the micro-optical components for beam formation as the only manual process. Assembling the micro-optics manually is a fairly time-consuming and costly process during the manufacture of diode laser modules. There are still no suitable beam-analysis algorithms that support the fully automated alignment of micro-optical components – especially fast-axis collimation lenses for high-powered diode laser bars – in six degrees of freedom.

Method

The power density distribution behind misaligned fast-axis collimation lenses is modeled as a function of the six-dimensional misalignment of the lens. Interrelationships are derived from the model and these provide a clear, quantitative prediction of the misalignment by analyzing the power density distribution in the near or far field. The misalignment can be corrected in a single step using the calculated prediction.

Other algorithms are also being developed that support iterative correction of the misalignment in those areas of beam distribution that are not, or not clearly, illustrated using models.

1 Microscope image of three FAC lenses.

Result

The power density distribution behind the misaligned fast-axis collimation lenses allows the required correction to be predicted with a maximum uncertainty of a micrometer. This brings the time taken for a typical alignment down to less than ten seconds.

Applications

The findings can be used in the field of production technology for high-power diode lasers in order to fully automate the production chain. The developed models and algorithms can be modified and tailored to other beam sources and micro-optics.

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