



## FIBER-COUPLED FARADAY ISOLATOR FOR HIGH-POWER FIBER LASERS

### Task

Fiber lasers are a standard tool for the industrial processing of metals, in sheet form as well as powder. When they are processed, the laser beam can reflect back into the beam source due to the dynamics in the melt pool or an unfavorable positioning of the beam path. Since the fiber laser is principally sensitive to such back reflections, isolators should prevent the back coupling of the reflected radiation into the source and enable the laser to operate stably and trouble-free.

### Method

The isolator presented here has been dimensioned for non-polarized fiber laser radiation with a beam parameter product of 3 mm x mrad. For this, the incident radiation is divided into two components, polarized perpendicularly to each other, with each then subsequently guided through a Faraday rotator. Before being coupled into the output fiber, both of the components are recombined. The isolator has input as well as output couplers for standard 100  $\mu\text{m}$  fibers with a core numerical aperture of 0.2.

### Result

The isolation amounts to over 24 dB at low power, and at 1 kW coupled power, it is larger than 20 dB, whereas the decrease of the isolation can be traced back to depolarization of the light by thermally induced stress birefringence in the TGG crystals. The transmission of fiber to fiber lies at approximately 80 percent at 1 kW coupled power.

### Applications

In all applications where materials are processed with fiber lasers, in particular for high power ranges, e.g. cutting, welding or selective laser melting, an isolator can be used to stabilize the process and, simultaneously, to protect the beam source from damage. Double-sided fiber coupling enables the isolator to be better integrated in the laser systems by the fiber-based beam guidance all the way to the processing optics.

This work was funded by the German Federal Ministry of Education and Research under the grant number 13N9890.

### Contact

Dipl.-Phys. Oliver Fitzau  
Telephone +49 241 8906-442  
oliver.fitzau@ilt.fraunhofer.de

Dipl.-Ing. Hans-Dieter Hoffmann  
Telephone +49 241 8906-216  
hansdieter.hoffmann@ilt.fraunhofer.de