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Technologie-Lizenz-Büro
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Constant laser pulse amplification by means of a special master oscillator power amplifier - MOPA

Background

In recent years, laser systems have been tweaked to ensure peak values in all areas (average power, peak power, repetition rate) and thus boost productivity. Flexible production processes also require solutions that allow for single pulse selection or 'pulse on demand'.

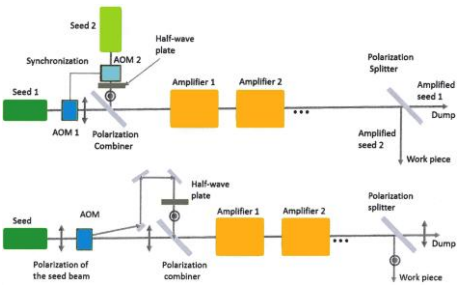
Problem

Current amplifier systems reach their limits if they have to switch or modulate the pulses quickly at high power and high repetition rates (multi-MHz). Even external, modulators exhibit limitation in speed or power handling and can be rather expensive. Therefore, they are used at an earlier stage (where the power is low) in the amplifiers chain. However, typical problems are the modulation of the pulse on the workpiece including excessively high energy of the first pulse, which might damage the system, or a strong fluctuation of the pulse energy over a series of pulses, which then leads to inconsistent processing results.

Solution

Thanks to the novel amplifier system it is now possible to ensure steady conditions within the amplifier chain at high power and repetition rates of the pulses during the switching operations and/or pulse modulation. Therefore, uniform pulse characteristics are created throughout the process.

In order to ensure maximum consistency, a second beam is added to the main beam, which passes through the amplifier, complimentary to the main beam. After passing through the amplifier, the second beam is separated by its polarization orthogonal to the main beam. Depending on the configuration, the system can be adapted to various polarization states (including radial or azimuthal polarization).



Two possible system configurations, generating the second beam and/or its coupling/decoupling in a different manner [IFSW, Stuttgart University].

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Service
Die Technologie-Lizenz-Büro GmbH ist mit der Verwertung der Technologie beauftragt und bietet Unternehmen die Möglichkeit der Lizenznahme.

Advantages

- ultrafast beam modulation at very high power and repetition rates
- constant pulse characteristics, in particular pulse energy
- stable beam on the workpiece
- suitable for pulse-on-demand applications
- suitable for linear as well as radial/ azimuthal polarization

Application

The amplifier system MOPA for high power, high modulation and/or switching speeds, which was developed at the Institut für Strahlwerkzeuge at the University of Stuttgart as part of an EU-funded project, offers an unprecedented uniformity of laser pulse characteristics, in particular in terms of power levels. This technique offers great advantages for downstream processes (material processing, etc.); in particular for applications that are equally dependent on high pulse rates (multi-MHz) and high average power (>1 kW).

Find out more

Detailed description of innovation:
https://www.ifsw.uni-stuttgart.de/dokumente/lasermagazin/2016_Lasermagazin_2_Ultrafast-RAZipol.pdf

Peer reviewed papers:

C. Röcker, A. Loescher, J. P. Negel, M. Delaigue, F. Morin, C. Hönninger, E. Mottay, P. Villeval, A. Holvoet, D. Lupinski, T. Graf, and M. Abdou Ahmed, "Direct amplification of sub-300 fs pulses in a versatile thin-disk multipass amplifier", Opt. Commun. 460, (2020).
https://doi.org/10.1016/j.optcom.2019.125159

C. Röcker, J.-P. Negel, A. Loescher, T. Dietrich, S. Piehler, B. Dannecker, T. Graf, and M. Abdou Ahmed, "Ultrafast thin-disk multipass laser amplifier scheme avoiding misalignment induced by natural convection of the ambient air", Opt. Eng. 58, 1 (2019).
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Jan-Philipp Negel, André Loescher, Benjamin Dannecker, Paul Oldorf, Stefanie Reichel, Rigo Peters, Marwan Abdou Ahmed, and Thomas Graf, "Thin-disk multipass amplifier for fs pulses delivering 400 W of average and 2.0 GW of peak power for linear polarization as well as 235 W and 1.2 GW for radial polarization", Appl. Phys. B (2017) 123: 156.
https://doi.org/10.1007/s00340-017-6739-2

André Loescher, Jan-Philipp Negel, Thomas Graf, and Marwan Abdou Ahmed, "Radially polarized emission with 635 W of average power and 2.1 mJ of pulse energy generated by an ultrafast thin-disk multipass amplifier", Opt. Lett. 40, 5758-5761 (2015).
https://doi.org/10.1364/OL.40.005758