SAND2016-11674C

SPIE Photonics West 2017, 28 January – 2 February 2017, San Francisco, California
Conference 10084, High Power Lasers for Fusion Research IV

Broad bandwidth high reflection coatings for petawatt class lasers: Femto- and pico-second pulse laser damage tests, and measurements of group delay dispersion

John Bellum[1]*, Trevor Winstone[2], Ella Field[1] and Damon Kletecka[1]

[1]Sandia National Laboratories, P. O. Box 5800, MS 1197, Albuquerque, NM 87185, USA
[2]STFC Rutherford Appleton Laboratory, Chilton, Didcot, Oxon, OX11 0QX, UK

***Corresponding Author (jcbellu@sandia.gov)**

Abstract: We designed and produced optical coatings for broad bandwidth high reflection (BBHR) of femtosecond (fs) and picosecond (ps) pulses of petawatt (PW) lasers. These BBHR coatings consist of TiO_2/SiO_2 or HfO_2/SiO_2 layer pairs formed by reactive e-beam evaporation with ion-assisted deposition. Specifications for HR center wavelength and spectral width of the coatings are for 45-deg angle of incidence (AOI), P polarization (Ppol), with use of the coatings at different AOIs providing corresponding different HR center wavelengths and spectral widths. These coatings must provide high laser-induced damage threshold (LIDT) to handle the PW fluences, and also low group delay dispersion (GDD) to reflect ps and fs pulses without distortion of their temporal profiles. We present results of LIDT and GDD measurements on these coatings. The LIDT tests are with 100 fs laser pulses of 800 nm center wavelength for BBHR coatings whose HR center wavelength is 800 nm, and with 150 ps laser pulses of 780 nm center wavelength for a BBHR coating whose design HR band is 773 nm +/- 50 nm. In the former case, tests are at 45-deg or 65-deg AOI, Ppol. In the latter case, the test is at 45-deg AOI, Ppol. We present GDD measurements for two BBHR coatings, whose design HR center wavelength is 900 nm in one case and 773 nm in the other case, showing reasonably low GDD over the HR bands. We report how the LIDT and GDD results compare with previous results of similar measurements.

Key words: Optical coatings, broad bandwidth high reflection, high laser-induced damage thresholds, group delay dispersion, petawatt laser pulses

Acknowledgement:
Sandia National Laboratories is a multi-mission laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Short Abstract: We designed and produced broad bandwidth high reflection (BBHR) coatings for femtosecond (fs) and picosecond (ps) petawatt (PW) laser pulses. HR center wavelengths and spectral widths vary according to AOI. Laser induced damage threshold (LIDT) tests are at

45-deg or 65-deg angle of incidence (AOI), P polarization (Ppol) with 100 fs pulses of 800 nm center wavelength, and at 45-deg AOI, Ppol with 150 ps pulses of 780 nm center wavelength. GDD measurements for two coatings show reasonably low GDD over the HR bands.