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Abstract

The ion beam deposition of $(NbTa)_2O_5$ has been investigated for realizing high reflectance multilayer stacks of high damage threshold for applications in the engineering of dielectric gratings for use at 800 nm. Deposition conditions were optimized to yield fully oxidized films as determined from x-ray photoelectron spectroscopy (XPS). The film properties were also investigated using spectroscopic ellipsometry, and spectrophotometry to determine their refractive index and thickness respectively. Damage threshold testing was performed on single films using an amplified Ti:Sapphire laser producing a train of 170 ps pulses at a wavelength of 800 nm with an average energy of 100 mJ. The laser output was focused at the surface of the samples via a 0.5 m focal length lens to generate fluences ranging from 0 to 9 J/cm^2.

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At the optimum deposition conditions for highest optical quality and damage threshold, high reflector stacks of $(NbTa)_2O_5$/SiO2 were fabricated. These stacks were employed to fabricate dielectric gratings with 1740 l/mm for use with 800 nm light. At an input angle of 8° from Littrow and a wavelength from 770 to 830 nm, >90% diffraction efficiency is achieved, with peak diffraction efficiency of >97%. The demonstration of dielectric gratings at 800 nm is opening the pathway to significantly increase the power handling capabilities of grating compressors for picosecond and femtosecond chirped pulse amplifications systems.

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