High reflectivity Bragg gratings fabricated by 248nm excimer laser holographic ablation in thin Ta_2O_5 films overlaid on glass waveguides

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Relief Bragg grating reflectors inscribed on channel waveguides may be used in optical communications as add-drop wavelength multiplexers, gain-flattening filters, distributed feedback laser mirrors, or in sensing technology as high sensitivity devices for precise monitoring of chemical or biomedical processes. We present strong Bragg grating reflectors in Ta_2O_5 thin oxide films overlaid on potassium ion-exchanged channel waveguides in BK-7 glass, inscribed using 248nm excimer laser holographic ablation. The grating pattern was created employing two-beam interference using a modified Mach-Zehnder interferometric cavity and the output of a narrow-lined injection cavity 248nm excimer laser. The experimental data presented are divided into two sections: the first section refers to the study of the grating ablation process of thin Ta_2O_5 films with respect to the exposure conditions; and the second focuses in the implementation of those relief grating in functional waveguide devices.

Firstly, experimental data on grating morphology versus exposure conditions (energy density and number of pulses), accomplished with real time diffraction efficiency measurements, AFM (Fig.1L) and SEM microscans are presented. This study is used for the quantitative characterisation and optimisation of the ablation process and the study of the physical mechanisms involved. The experimental data reveal that, depending on the exposure conditions, high-volume-damage or relief gratings may be formed in Ta_2O_5 thin films. In the second section diffraction spectra for waveguide gratings are presented and analysed. Spectral notches in transmission of depth more than 18dB for TM polarisation were obtained from 16mm long gratings patterned in waveguides overlaid with a 105nm thick Ta_2O_5 film, using 50 pulses of 60mJ/cm^2 energy density (Fig.1R). Dependence of the spectral data upon the exposure conditions and waveguide characteristics are presented and issues related to the application of holographic ablation in composite waveguides are also addressed.

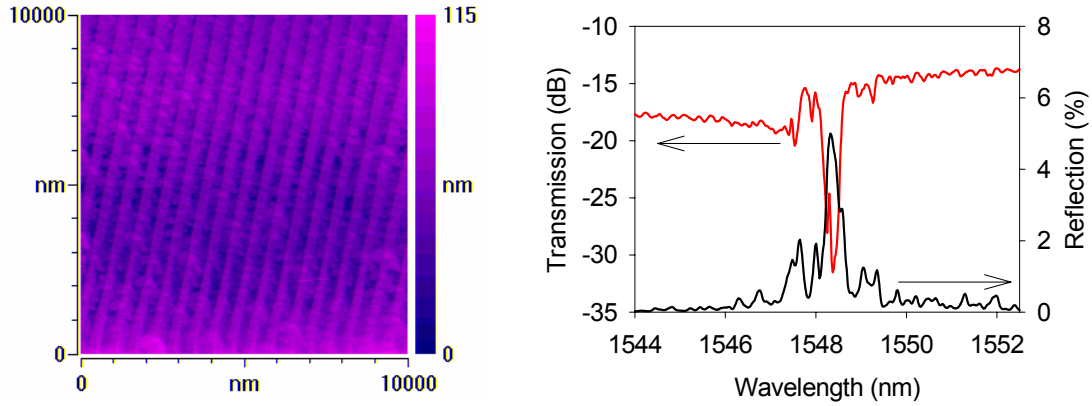

Figure 1: (Left) AFM scan of an ablated grating in a 105nm Ta_2O_5 thin film, using 50 pulses of 60mJ/cm^2 energy density. **(Right)** TM polarisation transmission and reflection spectra of 6mm wide channel waveguide grating, on a 105nm thick Ta_2O_5 overlaid film, ablated using 50 pulses of 60mJ/cm^2 energy density.

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