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ION FLUX–FILM STRUCTURE RELATIONSHIP DURING REACTIVE MAGNETRON SPUTTERING OF TUNGSTEN.

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In this work, we are aiming at evaluating the influence of the ion bombardment on the crystalline constitution of WO_3 thin films.The intensity of the ion bombardment has been tuned by using an unbalanced (UBM) and a balanced magnetron (BM) and by sputtering the magnetron cathode in different discharge regimes: DC magnetron sputtering (DCMS), pulsed DCMS (pDCMS), High Power Impulse Magnetron Sputtering (HiPIMS), and Modulated Pulse Power sputtering (MPP), with pulse duration ranging from 10-50 µs in HiPIMSto 500-1000 µs in MPP. The average power was kept constant to 400 W whatever the sputtering conditions.The main ion populations (Ar^+, O^+, WO_x^+) were monitored using an energy-resolved mass spectrometer while the ion current at the substrate was measured by using a Faraday cup. The data show that: (i) according to the discharge regimes, the ionic current increases by a factor of 2 to 5 as the UBM is used; (ii) the ion flux during HiPIMS and MPP discharges is significantly increased (3x) as compared to the DCMS and pDCMS regimes. Moreover, HiPIMS and MPP mass spectra highlight a significant increase in the number of singly and doubly charged W and Ar ions as compared to the DCMS discharge.
X-ray diffraction demonstrates that all films crystallize in the monoclinic phase. Nevertheless, the texturation of the films is affected by the sputtering conditions: a (0,0,2) texturation is observed for MPP, DCMS and pDCMS discharges; for the two latter cases, only for BM configuration. If the UBM configuration is used in these cases, a (2,0,0) texturation is observed. Finally, for HiPIMS deposited films, a (-1,1, 2) texturation appears.The comparable texturation between MPP and the low ion flux situation of the DCMS discharge (BM configuration) is explained by the increased deposition rate of the MPP sputtering plasma (~ 4 x DCMS) resulting in a reduced ion-to-neutral ratio as compared to the HiPIMS situation for example.

Keywords
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