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## Pulsed Magnetron Sputtering Systems Used for the Deposition of TiO<sub>2</sub> and TiO<sub>2</sub>:N Thin Films

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Pulsed planar magnetrons working in the low frequency HIPIMS mode and MF frequency pulsed mode were used as plasma sources for the deposition of TiO<sub>2</sub> and TiO<sub>2</sub>:N thin films on different types of substrates. The diameter of the titanium target was 50 mm. Ar, O<sub>2</sub> and N<sub>2</sub> were used as working gas mixture. A glass coated by ITO or ZnO:Al were used as the substrates for the deposition experiments. The low frequency HIPIMS mode used repetition frequency 50 Hz and the active part of the modulation cycle has 100 ms. Maximum current in the pulse was 60 A. The MF frequency pulsed magnetron system worked in the frequency range from 20-450 kHz with the average current 500 mA. In all the used sputtering systems, ion flux and heating flux on the substrate were measured. For this reason, AC voltage with the magnitude in the range from several tens of volts up to 150 V with frequency in the range from 50kHz up to 1 MHz was applied on the substrate. In addition, the measurement by time resolved Langmuir probe at the position of the substrate was used as well. Emission spectroscopy was used in order to investigate relative amount of sputtered Ti and Ti<sup>+</sup> atoms in particular sputtering system. Deposited films were analyzed by XRD in order to get information about crystalline structure. It was found that at certain conditions, pure anatase phase was obtained in the films without post deposition annealing. Chemical composition was measured by XPS. Surface morphology was investigated by AFM. Photoelectrochemical properties were measured in electrochemical cell in order to get information about induced photocurrent efficiency of the deposited films. The optical gap was measured by PDS in order to get accurate value also in the films with high light scattering.

### Keywords

magnetron  
HIPIMS  
TiO<sub>2</sub>  
sputtering  
thin films