

High rate reactive sputter-deposition of WO₃ films using two different deposition methods

Yoji Yasuda, Yoichi Hoshi

Department of Electronics and Mechatronics, Tokyo Polytechnic University

E-mail: yyasuda@em.t-kougei.ac.jp

Tungsten oxide (WO₃) is well known as a functional material with excellent gasochromic, electrochromic, and photocatalytic properties. Nano-structured WO₃ films prepared by glancing angle sputter deposition and high-rate gas flow sputtering were reported by Horprathum et al.¹⁾ and Oka et al.²⁾, respectively. We have already reported that high-rate deposition of WO₃ films at a deposition rate (R_D) of more than 100 nm/min³⁾ can be achieved by pulsed dc planar magnetron sputtering (PMS). However, poor gasochromic film was obtained near the center area of the substrate, as shown in Fig. 1(a). This was due to bombardment by high energy negative oxygen ions that are sputtered from a target surface to the substrate surface during sputter-deposition, as shown in Fig. 2(a). This ion bombardment is expected to be completely suppressed if the facing-target type low damage sputtering system (FTS) shown in Fig. 2(b) is used for the deposition process.

In this study, we deposited WO₃ films using two different sputtering methods (a PMS and an FTS system) and compared the structure and properties of the resulting films. Typical sputtering conditions are presented in the poster session. R_D of more than 120 nm/min was easily realized with an increase in the sputtering voltage above 700 V. A typical WO₃ film obtained by PMS exhibited inhomogeneous gasochromic properties that depended on the location on the substrate, and films with excellent gasochromic properties were only obtained at the corner of the substrate, as shown in Fig. 1(a). It was also found that the nonuniformity of the films can be improved by altering the angle of incidence of the particles on the substrate and relaxing the impact.

In contrast, uniform films were easily obtained by FTS, as shown in Fig. 1(b). Details will be presented in the poster session.

- 1) M. Horprathum et al., *Sensors and Actuators B*, 176(2013)685; 2) N. Oka, et al., *APL Materials* 3, 104407(2015); 3) Y. Yasuda et al., *TOEO* 10, 3pP28 (2017)

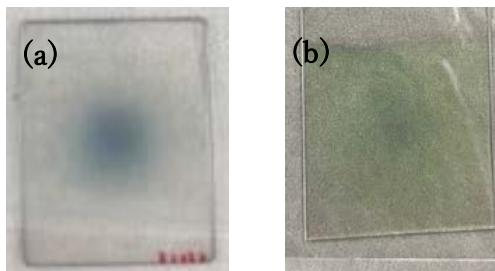


Figure 1 Typical photograph of the WO₃ films deposited by using (a) planar magnetron sputtering (PMS) and (b) facing-target type low damage sputtering system (FTS).

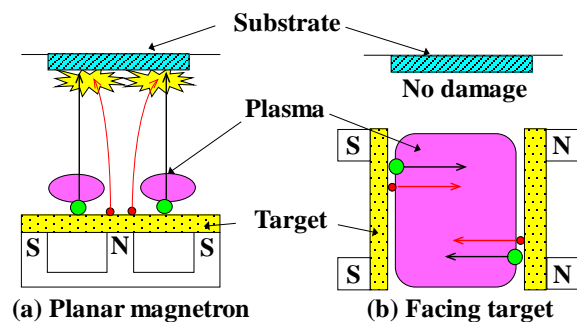


Figure 2 Substrate bombardment of deposition high energy negative oxygen ions and secondary electrons in PMS and FTS.