POSTER

Al_2O_3 ultra-thin films deposited by PEALD and ThALD for rubidium optically pumped atomic magnetometers

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The Atomic Layer Deposition (ALD) technique can be used to improve the rubidium optically pumped atomic magnetometers (OPMs) cell lifetime with a conformal deposition of Al_2O_3 ultra-thin film on the internal cell walls as a protective coating avoiding the disappearance of the alkaline metal vapor over time. In this work, 10 nm thick Al_2O_3 ultra thin-films by ThALD and by PEALD were deposited and compared. Trimethylaluminium (TMA) and pure water (H_2O) were used as the precursors for ThALD, whereas TMA and O_2-plasma were used for the PEALD avoiding oxidation by H_2O. The Al_2O_3 ultra-thin films were deposited at the same ALD reactor by a SENTECH system.

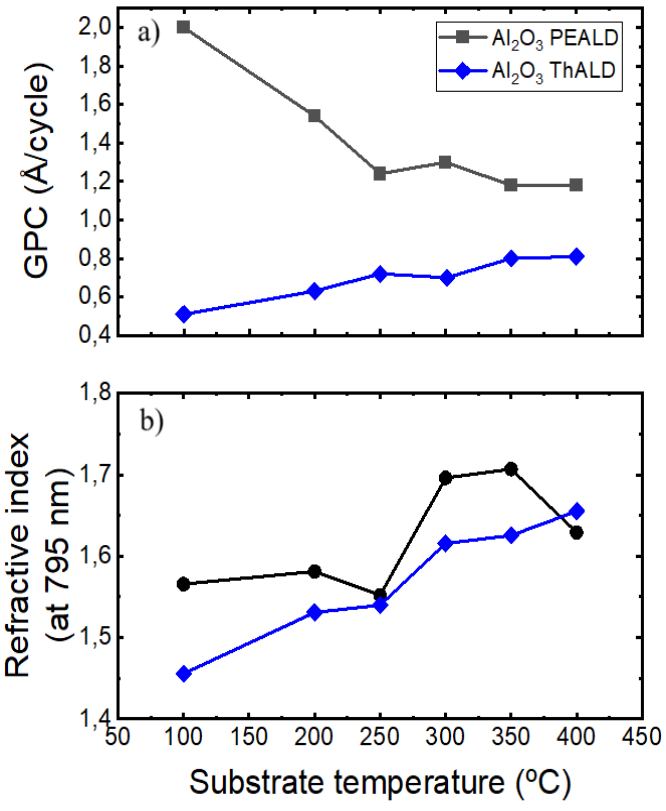

Figure 1. (**a**) ALD window; (**b**) Refractive index at 795 nm of Al_2O_3 ultra-thin films deposited by PEALD and ThALD.

The comparison was carried out by, optically characterization with an ellipsometer and chemically by the XPS (X-ray photoelectron spectroscopy) technique. The TMA pulverization time was 60 ms with a co-reactant time of 60 ms for the ThALD and 5 s for the PEALD. The ALD purge time was 2 s for each half-cycle. 140 cycles were deposited for ThALD and 90 cycles for PEALD. The XPS analysis allows to confirm oxygen rich Al_2O_3 ultra-thin films. Both ALD variants (ThALD and PEALD) obtained similar Al:O ratios, close to 34:55 by calculating the XPS peak areas of the Al2p and O1s. The GPC (Growth per cycle), the ALD window, and the refractive index at 795 nm (OPM operating wavelength) were investigated for substrate temperatures between 100-400 °C (Figure 1). The results promise an Al_2O_3 ultra-thin films recipe for an OPM conformal protective coating with lower absorption of the light dependent from the ALD variant and substrate temperature.

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