

## Supporting information

# High-throughput measurement of ionic conductivity in composition-spread thin films

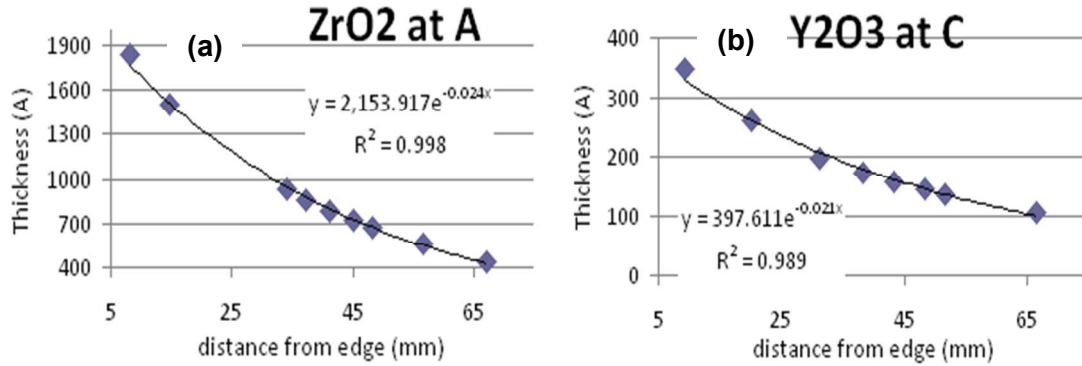
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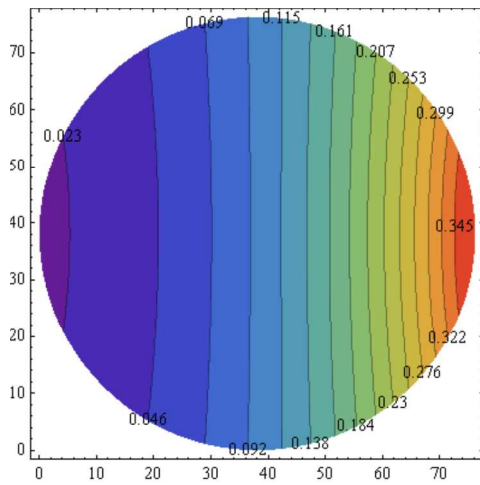
### **The determination of the composition over the composition spread**

Composition is a very critical parameter and special attention has been paid to determine it. We have found that, with high reliability: 1) the depositions of  $\text{ZrO}_2$  and  $\text{Y}_2\text{O}_3$  do not interfere with one other during co-sputtering and 2) the deposition rate is constant over time, with a negligibly small variation from run to run. These observations are documented in Ref. 1.

We used identical sputtering parameters to prepare  $\text{ZrO}_2$  and  $\text{Y}_2\text{O}_3$  composition spreads separately and used ellipsometry to determine the thickness at many spots along the symmetry axis. By fitting the thickness using an empirical model (Fig. S1), we get the thickness distribution over the whole composition spread. Then, after considering variables such as density, molecular weight, and deposition time, we infer the composition distribution of the  $\text{ZrO}_2$  and  $\text{Y}_2\text{O}_3$  composition spreads. Simple superposition of the deposition rates allows us to calculate the composition of the cosputtered  $\text{ZrO}_2$ - $\text{Y}_2\text{O}_3$  composition spread (Fig. S2). Local measurements (electron microprobe (WDS) and X-ray photoemission) showed agreement with calculated composition values within the error limit of measurement technique. Previous (unpublished) work has demonstrated agreement between the calculated compositions and compositions measured using Rutherford Backscattering Spectrometry, the “gold standard” for thin film composition determination, within the  $\pm 3\%$  absolute composition confidence interval associated with that measurement technique.



**Fig. S1** The fitting of thickness distribution of (a) ZrO<sub>2</sub> and (b) Y<sub>2</sub>O<sub>3</sub> composition spreads, solid diamonds- experimentally measured values, line- fitted values.



**Fig. S2** The estimated composition distribution of ZrO<sub>2</sub>-Y<sub>2</sub>O<sub>3</sub> composition spreads with the RF powers of Zr and Y targets to be 103 W and 50 W.

(1) Gregorie, M.; Dale, D.; Kazimirov, A.; DiSalvo, F. J.; van Dover, R. B. Cosputtered composition-spread reproducibility established by high-throughput x-ray fluorescence. *J. Vac. Sci. Technol. A* **2010**, 28, 1279-1280.