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Nanostructured thin films of yttria-stabilized zirconia

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Nanostructured thin films offer the potential for significant advances in the performance of new and established materials having great technological potential in several applications, such as thermal barriers, gas storage systems, optical devices, gas and humidity sensors. A possible synthesis route for nanostructured thin films is glancing angle deposition [1] but this technique suffers from a low deposition rate. In this paper an alternative method is discussed based on a compositional gradient over the thin film grown. The work focuses on the deposition of YSZ (Yttria Stabilized Zirconia) thin films by reactive magnetron sputtering from two sources, i.e. an yttrium and a zirconium target. The variation of deposition conditions such as gas pressure, Y target-substrate distance, enables us to modify the film morphology and texture.
Combining the results obtained via X-ray diffraction and pole figures, the texture and microstructural evolution can be described quantitatively. From these measurements it is clear that the constituent columns are bent. The average column tilt is defined by the compositional gradient, by the crystal size and by the difference in cation radius between zirconium and yttrium. Also, the specific geometry of the experimental set-up has its influence on the column tilt. The latter can be exploited to nanostructure the thin film. For example, by periodically rotating the sample during deposition, zig-zag columns can be formed.
[1] B. Dick, M.J. Brett, and T. Smy. Journal of Vacuum Science & Technology B, 2003. 21(6): p. 2569-2575.

Keywords
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