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Thickness dependent wetting properties of thin stoichiometric hafnium oxide films

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1 Introduction

Hydrophobic ceramic is a class of materials which combine high hardness, excellent thermal stability, wear resistance and values of contact angle with water close to values for organic- and fluoro- polymers. This combination allow to produce robust hydrophobic surfaces for harsh environments, such as dropwise condensation heat transfer or stable anti-ice protective coatings. We report on thickness dependent wetting properties and surface free energy of thin films of hafnium oxide (HfO_2) as a good example of such material.

2 Results

We used the reactive high power impulse magnetron sputtering with a pulsed reactive gas flow control as a novel technique capable of producing dense stoichiometric films with smooth surfaces and well controlled thickness down to units of nm. HfO_2 films were prepared as a typical case of a low-electronegativity-metal based ceramic. It was found a thickness dependence of the water droplet contact angle ranging from 120º for the thickness of 50 nm to 100º for the thickness of 2300 nm considered as bulk material. The Lifshitz-van der Waals component of the surface free energy remained the dominant component throughout the range of measurement and exhibited a corresponding thickness dependence. The XRD and FTIR showed only minor differences among the films.

3 Conclusions

We show that stoichiometric HfO_2 films with enhansed hydrophobic properties can be prepered by reactive high power impulse magnetron sputtering with a pulsed reactive gas flow control. The values of water droplet contact angle can be controlled by film thickness.

References

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