MECHANICAL BEHAVIOR OF ANNEALING-INDUCED BLISTERING OF ATOMIC LAYER DEPOSITED ALUMINA-TANTALA THIN FILMS

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Beams and cantilevers of microelectromechanical systems need to withstand mechanical bending while maintaining their other functional properties, like high conductivity or resistivity [1]. Proposed method to increase the flexibility of brittle ceramic thin films is wrinkling, which has shown to improve the bending fracture strain of indium tin oxide film [2]. Atomic layer deposited Al_2O_3 thin films are known to form delamination blisters (Fig. 1) after annealing at temperatures higher than 500 °C due to H_2 diffusion and build up at Al_2O_3-Si interface [3]. Blistering could similarly to wrinkling affect the flexibility of thin films. In this study, the effect of annealing environment and layered structure on the blistering of thin films were investigated. It was found that blistering occurs in a different temperature range in high vacuum conditions compared to atmospheric pressure. When layering alternately Al_2O_3 with Ta_2O_5 films, planar density of blisters is affected by the thickness of a single layer. Multilayered structure of Al_2O_3-Ta_2O_5 thin film also affects its mechanical hardness [4]. Thin films, which consisted of Al_2O_3-Ta_2O_5 mixture rather than distinct layers demonstrated blistering, too. It could be possible to modify the flexibility and hardness of oxide thin films by changing the single layer thickness and applying annealing treatments in different environments.

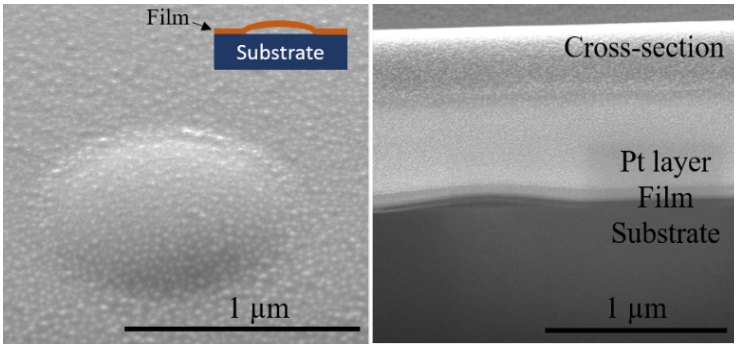

Fig.1 Scanning electron microscope image of surface morphology and cross-section of a blister of Ta_2O_5/Al_2O_3 film after annealing 10 min in air at 700 ºC.

References

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