Special Interest Talks

Room Town & Country A - Session SIT1-MoSIT

Special Interest Session I

Moderator: Jyh-Wei Lee, Ming Chi University of Technology, Taiwan

1:00pm **SIT1-MoSIT-1 Residual Stress Measurement on Hard Coatings and the Evaluation of Energy Relief Efficiency of Architectured Coatings*, Jia-Hong Huang,*** National Tsing Hua University, Taiwan **INVITED**

Hard coatings deposited by physical vapor deposition are usually sustained high residual stress that could lead to many problems in the applications, such as delamination and spallation of coating, thereby reducing the service duration of the products. To solve residual stress problem in hard coatings, the stress should be correctly measured. In the first part of this talk, the method of stress measurement will be reviewed, mainly focusing on the $\cos^2\alpha\sin^2\psi$ X-ray diffraction method [1] and a recent developed technique, the average X-ray strain (AXS) method, which was a more accurate technique based on the previous $\cos^2\alpha\sin^2\psi$ method [2]. Examples of the applications will be briefly mentioned. In the second part of the talk, the estimation of stress relief efficiency by metal interlayer using an energy balance model will be introduced. One of the most common approaches in dealing with residual stress issue is by introducing a metal interlayer in between the hard coating and substrate, by which residual stress is expected to be partly relieved and adhesion strength of the coating may be enhanced. However, the selection of metal and the thickness of interlayer is usually based on empirical rules without theoretical basis. Therefore, the efficiency of stress relief by using a specific metal with a certain thickness cannot be properly estimated. Recently, we proposed an energy balance model to evaluate the energy relief efficiency by the interlayer and further understand the relation between stress relief and plastic deformation [3]. The model hypothesized that stored elastic energy in the hard coating and the bending energy in the Si substrate could be partially relieved by the plastic deformation of the metal interlayer. The model has been applied on TiN/Ti, ZrN/Ti and ZrN/Zr bilayered coatings on Si substrate, where the energy relief efficiency can be estimated; furthermore, the contributions of energy relief by hard coating and substrate are separately assessed. The model was also applied on TiZrN/TiN/Ti tri-layered coatings on Si substrate, and the energy relief efficiency was successfully evaluated.

Reference

[1] C.-H. Ma et al., Thin Solid Films 48 (2002) 73.

[2] A. Wang et al., Surf. Coat. Technol. 262 (2015) 40.

[3] J. -H. Huang et al., Surf. Coat. Technol. 434 (2022) 128224.

Special Interest Talks

Room Town & Country A - Session SIT2-TuSIT

Special Interest Session II

Moderator: Jyh-Wei Lee, Ming Chi University of Technology, Taiwan

7:00pm **SIT2-TuSIT-1 Functional Nitride and Oxide Thin Films – the Key to Our Digital World*, Joerg Patscheider,*** Evatec AG, Switzerland **INVITED**

Modern telecommunication depends heavily on assemblies of integrated devices that are composed of most intricate combinations of functional thin films. Nitrides and oxides present an important category among these functional thin films, as their electrical properties allow for tailoring electric currents to build logical elements such as transistors, RF filter devices and memory architectures, to name just a few applications. Moreover, the bandgap of many of these materials may be tuned by alloying with additional elements to tune their electrical and optical properties.

This contribution will present examples from different fields of importance for applications that are driven by the ever-increasing market for handheld devices such as smartphones and smartwatches. We will look at piezoelectric films of AlN and AlScN for frequency filters, shed light on integrated transformers consisting of multilayered ferromagnetic films with intercalated insulators and dive into the world of multilayered oxide coatings for various optical filter applications.

These examples with their respective technological challenges necessitate corresponding equipment concepts for volume manufacturing. Advanced control of thickness and residual stress uniformity, prevention of cross-contamination and parallel processing solutions will be explained. Manufacturing techniques to produce thin films on 8” and 12” wafer level meeting the stringent requirements of today’s semiconductor and optical industry will be presented.

Special Interest Talks

Room Town & Country A - Session SIT3-WeSIT

Special Interest Session III

Moderator: Jyh-Wei Lee, Ming Chi University of Technology, Taiwan

1:00pm **SIT3-WeSIT-1 Thin Film Sputtering Technologies Enabling Manufacturing of Functional Devices for Smart Society**, ***Koukou Suu***, ULVAC, Inc., USA **INVITED**

Functional materials from thin film technology are finding new applications. Sputtering is one of the critical processes to deposit thin films. Industry needs reliable and reproducible sputtering solutions. ULVAC has been developing sputtering equipment and technology using Radiofrequency (RF) for functional materials deposition. Sputtering has a wide range of applications in BST, STO, PCM Memory, Electrolyte Materials of Lithium Ion Battery and PZT. Piezoelectric PZT thin films, one of ULVAC's leading technologies, have been used to fabricate advanced piezoelectric MEMS (Piezo-MEMS) devices, such as gyro/acceleration sensor, microphone, piezoelectric micro-machined ultrasonic transducer (pMUT), μ-mirror and pyroelectric sensor. These devices have been identified as key enabling technologies for "Smartphones," "Wearable devices," and "Autonomous cars," which are rapidly becoming one of the most important components of a modern "Smart Society's" "Smart infrastructure." ULVAC provides CMOS-compatible solutions for Piezo-MEMS device integration in order to realize next-generation IoT applications for smart societies. A brief overview of how we developed an original sputtering module and stable advanced process technologies, including the low temperature crystallization technique of PZT, will be presented in this talk.

Author Index

Bold page numbers indicate presenter