INTERNATIONAL CONFERENCE ON METALLURGICAL COATINGS AND THIN FILMS

PROGRAM AND ABSTRACTS

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provide experimental mean for determining the limit of Si solubility in Zr-Si-N ternary systems and for following the thickness evolution of the SiNy layer in the composite films.The structure and morphology of films are responsible for the film hardening through a 2-step mechanism, i.e., by forming a solid solution of Si atoms in ZrN lattice and by forming a nanocomposite material.

BP-69 Stress Dependence of Texture in Arc Evaporated Ti-Al-N Thin Films, *C.V. Falub*, EPFL, Switzerland, *V.H. Derflinger*, Balzers AG, Liechtenstein, ***A. Karimi*** *(ayat.karimi@epfl.ch)*, EPFL, Switzerland

In view of the superior performance of TiN at lower temperatures and the higher oxidation resistance, hardness and abrasive resistance of TiAlN at higher temperatures, the TiN/TiAlN multilayer system is a possible candidate to fulfill the requirements of the cutting tool market. An approximately 4.5 μm thick TiN/TiAlN multilayer was deposited by means of PVD method on cemented carbide and tool steel substrates. The multilayer period is composed of a 160 nm thick TiAlN layer and a set of thinner alternating TiN and TiAlN layers with a total thickness of 140 nm. XRD polar scan measurements revealed that the crystallites are strongly textured with the preferred orientation inclined from the normal direction towards the sample surface with an angle of about 18°. The difference in compressive residual stress of the films deposited on cemented carbide and tool steel is explained by the difference in the linear expansion coefficient of the two substrates. Evolution of residual stress and texture in the different TiN and TiAlN sublayers during annealing will be discussed. The microstructure of the coatings investigated by means of SEM, TEM and XRD is correlated to the mechanical properties of the coatings determined from nanoindentation and four-point bending tests.

Optical Thin Films
Room: Town & Country - Session CP

CP Poster

CP-1 Self-Assembled Growth and Plasmon-Enhanced Green Emission of Gold Nanowhisker Coatings, ***T. Qiu***, *X.L. Wu, P.K. Chu (paul.chu@cityu.edu.hk)*, City University of Hong Kong, PR China

Recent experiments have shown that there are surprisingly strong metal-metal interactions between gold atoms in molecular complexes, and chemists have started to use them to design new structures with unusual physical properties. Photoluminescence (PL) of gold nanostructures is interesting from the perspective of electroluminescence devices in which semi-transparent gold electrodes are used. In this paper, we present a relatively rapid method to fabricate gold nanowhisker coatings with a unique structure by electroless metal deposition on Si wafers in a KAuCl4-HF solution. A self-assembled localized microscopic electrochemical cell model and diffusion-limited aggregation process are described for the formation of the Au nanowhisker coatings. A green PL band is recorded and spectral analyses suggest that the green PL arises from the radiative recombination of sp-band electrons with d-band holes in the Au nanowhisker coatings and its intensity enhancement is due to local electric field associated with the Au particle plasmons oscillation. A red PL band is also observed from the etched Si substrates and believed to be related to the Si nanocrystals in the surface layer of the etched Si wafer. The good stability arises from the formation of stable SiAu bonds on the surfaces of the Si nanocrystals.

CP-2 Effect of Substrate Temperature and Annealing Treatment on the Electrical and Optical Properties of Silver Based Multilayer Coating Electrodes, *D.R. Sahu (sahu@mail.ncku.edu.tw), C.-Y Chen,* ***S.-Y Lin****, J.-L. Huang*, National Cheng Kung University, Taiwan

Multilayer coating consisting of thin silver layers sandwiched between layers of transparent conducting metal oxides are investigated from the view pint of low resistance electrodes for use in flat panel displays, solar cells etc.. ZnO/Ag/ZnO multilayer films were prepared on glass substrates by simultaneous RF magnetron sputtering of ZnO and dc magnetron sputtering of Ag. Optimization of the deposition conditions of both layers and metallic layers were performed for better electrical and optical properties. The structural, electrical and optical properties of the films (deposited at room temperature, different substrate temperature and annealed at different conditions) were characterized with various techniques. We could not get high quality transparent electrode under the condition of various substrate temperature. The surface roughening due to the agglomeration during substrate heating resulted in more scattering of the incident light causes reduction in transmittance and the sheet resistance was also increased by the enhanced surface scattering effect. However, improved electrical properties and considerable shift in the transmittance curves was observed after heat treatment. The experimental results show that the electrical resistivity of as grown films can be decreased to 10-5 -.cm level with post annealing at 400°C for 2h in vacuum atmosphere. By heat treatment the sheet resistance was reduced as much as 25% which was due to the increased grain size of Ag film. The samples heat treated at 200-400°C under vacuum or nitrogen atmosphere showed the best electrical properties. The key to the superior electrical and optical properties of the multilayer is the optimization of growth condition of the silver layer by careful control of the oxide properties and the use of appropriate annealing temperature and atmosphere.

[1]CO, multilayers, Optical and electrical properties.

CP-4 Study of Aluminum-Doped SnO_2 Transparent Conducting Films Prepared by Sol-Gel Method, ***H.C. Kim***, *Hyeong-H. Park, Hyung-H. Park (hhpark@yonsei.ac.kr)*, Yonsei University, Korea

Conventional n-type transparent conducting oxides (TCOs) have been investigated for more 40 years. Optical transparency over 90% and resistivity less than 1 x 10^{-4}Ωcm have been demonstrated. Recently new TCO materials have been studied to alternate ITO and realize p-type TCO. The p-type TCOs are necessary for the fabrication of inorganic transparent p-n junctions. Needless to say, the junction is an essential structure in a wide variety of optoelectronic semiconductors and transparent transistor of n-type and p-type TCOs can be used for transparent display panel. In this work, SnO_2 films were prepared on glass substrate by sol-gel procedure and doping effect of Al on the crystallization, resistivity, transparency, and energy band structure of SnO_2 thin film was investigated. Acceptor doping in semiconductors produces holes and increase hole concentration and p-type conductivity. X-ray diffraction and ellipsometry were served to provide the information of the crystalline structure and thickness of films. Scanning electron microscopy was used to investigate the microstructure of films. The optical transmission spectra of the films were obtained by using UV-VIS-NIR spectrophotometer and optical band-gap energy was calculated.

CP-5 Secondary Electron Emission Coefficient of MgO-NiO Composite Thin Films as a Transparent Layer for PDPs, *A. Ide-Ektessabi (h51167@sakura.kudpc.kyoto-u.ac.jp),* ***A. Nakao***, *Y. Morimoto, Y. Tanaka*, Kyoto University, Japan

Magnesium oxide (MgO) thin film is very important as a protecting layer for recent AC-type plasma display panels (AC- PDPs) because of its transparency and high secondary electron emission coefficient γ. The γ is one of the most significant factors for the protecting layer because greater numbers of electrons decrease an ignition voltage and a sustaining voltage, and this results in reduction of electric power consumption of the PDPs. Although the MgO thin film is commonly used, it is essential to develop new materials possessed higher γ for further progress of PDPs industry. In order to overcome the γ of pure MgO, adding some materials of which band gap are low is effective way. In this study, the authors focused nickel oxide (NiO) and added it to MgO thin films in various concentrations. The relationship between the γ and the concentration of Ni was investigated. To obtain the values of γ, two types of measurement systems were developed. One of them measured a breakdown voltage and the γ was calculated using Townsend coefficient. The other measured the γ directly by irradiating inert ion beam to the thin films. All the prepared thin films were annealed at constant temperature (400°C). Other characteristics of the thin films were also investigated using Rutherford backscattering spectroscopy (RBS), X-ray diffraction (XRD), Atomic force microscope (AFM), and X-ray photoelectron spectroscopy (XPS). The result shows that the change of the concentration of the added-NiO causes the change in the surface chemical condition and the crystal structure. Moreover, the secondary electron emission coefficient γ was improved with the concentration of added-NiO.

CP-6 Effect of Oxygen Concentration on the Properties of AnO:In Films by Simultaneous RF and DC Magnetron Co-Sputtering, *C.-Y Chen,* ***D.R. Sahu****, J.-L. Huang (jlh888@mail.ncku.edu.tw)*, National Cheng Kung University, Taiwan

The ZnO:In films were prepared by simultaneous radio frequency (RF) magnetron sputtering of ZnO and dc magnetron sputtering of metal In. The effects of oxygen concentration on the electrical and optical properties of ZnO:In films were investigated. Crystalline structure, roughness characteristics electrical and optical properties of the films were studied by XRD, AFM, four-point probe and UV-VIS spectrophotometer. Deposition conditions of the films were optimized to obtain a good quality transparent conducting ZnO:In films. When the oxygen flow rate increased from 4 to 24 sccm, the crystalinity of films increased. The minimum resistivity of ZnO:In films at O_2 flow rate of 16 sccm was 1.51 x 10^{-3} Ω.cm, which is mainly due to the higher product of carrier concentration and mobility. At various O_2 flow rate, variation of visible transmission of ZnO:In films was