Surface Engineering
Room: Exhibit Hall B2 - Session SE-TuP

Poster Session

SE-TuP2 Optimum Combination of Surface Roughness for Materials with Smooth Sliding in a Vacuum, ***A. Kasahara***, *M. Goto, T. Oishi, M. Tosa*, Nanomaterial Laboratory, Japan

We used a probe of stainless steel sphere with surface roughness of 60nm, and we measured friction of stainless steel substrate which with surface roughness prepared on a submicron scale. As a result, the materials with about 100nm surface roughness showed same friction force in a vacuum as the force out as atmospheric pressure. However, frictional force is generated by relative movement between materials. Therefor we studied a difference of surface roughness of probe and form of surface roughness of a sample in order to obtain the most optimum combination condition for smooth sliding in a vacuum.We measured frictional force of stainless steel sheet surface roughness of 110nm by probes with diameter of 3.18mm and with surface roughness of 60nm,100nm and 200nm. we also used titanium and copper sheets with surface roughness polished on a submicron scall and studied relation between a direction of sliding and generated friction force. The results showed decrease in friction force under optimum combination conditions that surface roughness of substrate was smaller than that of probe with surface roughness of about 100nm and that surface grove line patterns of sliding probe and substrate cross each other at right angles.

SE-TuP3 Three-dimensional Surface Structures Created by PVD Method, ***I.G. Levchenko***, *M. Romanov*, Kharkov Aerospace University, Ukraine

We describe a new class of the plasma coatings namely the three-dimensional surface structures, as well as the technique of deposition and methods for calculating the main process parameters. These special films were produced with a view to increase a coating service life under the hard loading conditions, especially when fatigue endurance and wear resistance are the most critical factors. We created the real three-dimensional surface structures of a faceted multi-layer hard-ceramic film consisting of facets separated with the pure metal. As the hard-ceramic film, the titanium nitride and zirconium nitride composition was used. The mask technology was used for production of these structures. According to the concept proposed, the pure metal separator is used as a solid-state lubricant. Besides, the use of isolated hard-ceramic facets provides increased adhesion strength and adhesion fatigue limit; this enables deposition of relatively thick films (up to 40 micrometers) without loss of the adhesion stiffness, and prolongs the film service life before delamination. For deposition of these films, we used the molybdenum masks with various transparency factors and various facet shapes. The films were deposited using vacuum-arc deposition equipment that provides generation of the filtered ion flow free of droplets. The wear tests showed considerable increase in the wear-resistance and decrease in friction coefficient when the steel was used as the rider. For cylindrical sliding couple, the fatigue test was performed that had proved the efficiency and utility of this kind of technology.

SE-TuP4 Electron Transport Characteristics of Ultrathin Cu Films Analyzed by In-situ ac Impedance Spectroscopy, ***S.Y. Park***, *Y.H. Hyun*, Hanyang University, Korea, *J.Y. Rhee,* Hoseo University, Korea, *Y.P. Lee*, Hanyang University, Korea

The impedance and resistance are measured simultaneously by using in-situ impedance spectroscopy and I-V source during the deposition of Cu films with a thickness of 1 to 7 nm onto a glass substrate. The growth stages of films, such as the discontinuous, semicontinuous, and continuous regimes, are determined by analyzing the AC impedance spectra in addition to the rather traditional DC method. We also observed that the percolation threshold thickness is 2.5 nm by either method and that the boundary for continuous stage is 3.3 nm. The complex dielectric moduli of films thinner and thicker than 2.5 nm could be described with a parallel R-C and a series R-L equivalent circuit, respectively. It is found that the relaxation time and the inductance for the semicontinuous and continuous films are increased with increasing the film thickness, and that the changes are discussed by considering the roughness and grain-boundary scattering effects. The mechanism of growth for a variety of ultrathin films could be elucidated by applying in-situ impedance spectroscopy.

SE-TuP6 Copper Seeding on the Tantalum-insulated Silicon Oxide Film by Ion Beam Assisted Deposition for the Growth of Electroless Copper, *S. Han*, National Taichung Institute of Technology, Taiwan, R.O.C., *C.J. Yang*, National Chung Hsing University, Taiwan, R.O.C., *J.H. Lin*, National Tsing Hua University, Taiwan, R.O.C., *Z.C. Chang*, *C.H. Hsieh*, National Chin-Yi Institute of Technology, Taiwan, R.O.C., ***H.C. Shih***, National Tsing Hua University, Taiwan, R.O.C.

The major aim of this study is to combine the techniques of using ion beam assisted deposition (IBAD) and electroless plating to deposit Cu onto a Ta diffusion barrier layer in order to accomplish the ULSI interconnection metallization. Distribution and depth of the implanted Cu was measured by secondary ion mass spectroscopy (SIMS) profiling. The crystallinity of the electroless plated Cu was analyzed by x-ray diffraction (XRD). Cross-sectional transmission electron microscopy (XTEM) and field emission scanning electron microscopy (FESEM) were used to elucidate the growth mechanism of the electroless deposited Cu film on the Cu-seeded layer by IBAD. The surface morphology of the films was observed by atomic force microscopy (AFM). This study successfully combines the techniques of IBAD and electroless plating for Cu to provide an appropriate quality for the gap-filling submicron trenches and vias with excellent step coverage.

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