Surface Science Division Room Hall A - Session SS-ThP

Surface Science Division Poster Session

SS-ThP1 Photon-Induced Localization and Correlation Effects in Optically Absorbing Materials, *D.E. Aspnes*, North Carolina State University; *L. Mantese*, University of Texas, Austin; *K.A. Bell*, North Carolina State University; *U. Rossow*, Technical University of Ilmenau, Germany

Surface-optical data that contain structures related to energy derivatives of bulk critical points show that photons themselves modify the optical properties of the material being measured, and therefore, that the standard picture of optical absorption must be revised. Using a simple model that retains correlations discarded in the random phase approximation yet can be solved analytically to first order in timedependent perturbation theory, we show that (1) the final electron and hole states are localized near the surface by the finite penetration depth of the photons but (2) these final-state packets also evolve by propagation with their respective group velocities. More important, since the energy of a wave function is the expectation value of the Hamiltonian, for finite packets the surface contribution to the energy and lifetime is also finite, thereby providing a natural explanation to derivative structures and to apparent differences in nominally bulk critical point energies and broadening parameters with surface preparation. Further, we show that (3) broadening must be described by a sinc function as in standard filter theory, instead of the traditional phenomenological broadening parameter. The implications are extensive. For example, these results show that (4) slab calculations of surface electronic properties, where limited spatial extent is an unwelcome consequence of limited computing power, may actually provide a more accurate representation of surface optical spectra than hypothetical calculations that take the entire bulk into account.

SS-ThP2 Study of Aluminum Deposition on GaN (0001)@footnote 1@, H. Cruguel, Y. Yang, S.H. Xu, G.J. Lapeyre, Montana State University; J.F. Schetzina, North Carolina State University

GaN has attracted much attention because of its great importance in fabricating light emitting diodes (LED), detectors and laser devices which operate in the green, blue and ultraviolet range. The vapor (in situ) deposition of Al on wurzite n-GaN(0001) clean surface is investigated with high-resolution photoemission. The samples grown at North Carolina State University were successfully clean by several techniques and measured at the Wisconsin Synchrotron Radiation Center (SRC). We have measured both Al 2p and Ga 3d photoemission level for different coverage of Al on GaN. With the Voigt line fitting of Al 2p we found two components, in addition to the metallic component, for all the deposition. The behavior is attributed to the formation of both AlGa@sub x@N@sub 1-x@ and AlN compounds on the GaN surface. The explanation is in agreement with the line fitting of Ga 3d level which also shows three components (bulk GaN, AlGa@sub x@N@sub 1-x@ and metallic). When we anneal the sample after the Al deposition the metallic peak disappears but the intensity of the two other components of the AI line and the components in the Ga line associate with AlGa@sub x@N@sub 1-x@ are still increasing. This means that the reaction still occurs and that the thickness of the two compounds increases. In addition we have deposited Mg on the sample to determine which compound is nearest the surface. We found that a metallic peak is only observed in Al 2p spectra. The results suggest that the sequence of materials is AIN on top, following by AlGa@sub x@N@sub 1-x@ and then GaN. The interpretation of the data will be presented. @FootnoteText@ @Footnote 1@ Research supported by ONR/DEPSCOR grant, SRC supported by NSF.

SS-ThP3 Adsorption Site of Mg on GaN(0001) from Photoelectron Holography Imaging, S.H. Xu, H. Cruguel, Y. Yang, Montana State University; J.F. Scheitzina, North Carolina State University; G.J. Lapeyre, Montana State University

The adsorption sites of Mg on GaN(0001) with and without predosed atomic hydrogen have been determined by the small-cone photoelectron holographic imaging(PHI) technique.@footnote 1@ The experiments were performed at the Iowa/Montana State University beamline at Synchrotron Radiation Center(SRC) in Madison. The diffraction data is directly inverted without the need for models to observe the local site of the Mg emitter. The GaN samples were grown with the MOCVD method. In the analysis chamber the samples were cleaned by several heatings at about 850 °C, and the sample showed a good 1x1 LEED net. After dosing with atomic

hydrogen followed by deposition of 0.5 ML Mg, the 1x1 LEED net is still observed but with a higher background. A set of 82 emission spectra by photon energy scans at the constant initial energy(CIS) of the Mg 2p level were measured. The angles for the set of CIS span a grid over one-sixth of the emission hemisphere(the surface irreducible symmetry element). The PHI images show that the adsorption sites in each case is different. With H interlayer, Mg adsorbs in a three fold site with an atom directly below the Mg emitter, usually called the T4 site. The adsorption height is about 1.4 Å above the Ga adlayer. Without the H interlayer, Mg likes to replace the 6a atoms in adlayer. The observations suggested that the H interlayer plays a key role in preventing Mg from diffusion into GaN bulk by not interchanging with the Ga atoms. This work is supported by ONR/DEPSCOR grant, SRC supported by NSF. @FootnoteText@ @footnote 1@Huasheng Wu and G. J. Lapeyre, Phys. Rev. B 51, 14549(1995)

SS-ThP4 Time-Resolved RHEED Studies of Ge(111)-c(2x8) <-> (1x1) Phase Transition, X.L. Zeng, B. Lin, H. Elsayed-Ali, Old Dominion University

The dynamic behavior of Ge(111)-c(2x8) <-> (1x1) phase transition was investigated by time-resolved reflection high-energy electron diffraction which employs a 100 ps electron pulse as a RHEED probe synchronized with 100 ps 1.06 μ m laser pulse to produce a transient surface temperature rise. By recording the RHEED intensities of (0,1/2) and (0,1) spots, the transient process of the reconstruction phase transition was monitored. First, our static RHEED study shows that Ge(111)-c(2x8) reconstruction state starts to disorder at the vicinity of 500K and are converted to a highly disordered adatom arrangement at 573K. Second, the time-resolved RHEED measurements are carried out by biasing the Ge(111) sample at 500K and using IR laser to produce a transient surface temperature jump as high as 130K. Under these conditions the Ge(111)-c(2x8) reconstructed adatom arrangement remains ordered up to 630K for a time duration of 400 ps, which is well above the characteristic temperature of 573K for the Ge(111)-c(2x8) <-> (1x1) phase transition.

SS-ThP5 Correlation Effects and Origin of the Phase Transition in Pb/Ge(111), A. Mascaraque, Universidad Autonoma Madrid, Spain; J. Avila, M.C. Asensio, LURE and CSIC, France; E.G. Michel, Universidad Autonoma Madrid, Spain

The @sr@3 x @sr@3-Pb/Ge(111) structure undergoes a phase transition to a @sr@3 x @sr@3 phase at low temperature (LT),@footnote 1@ which has been interpreted as the stabilization of a charge-densitywave.@footnote 1@ The role of correlation effects and Fermi surface (FS) nesting as driving forces of the transition has been considered.@footnote 1,2@ We report an investigation on the electronic structure and Fermi surface of Pb/Ge(111) along the phase transition using angle-resolved photoemission. Pb/Ge(111) exhibits a prominent Pb p@sub z@ dispersing surface state at RT, that splits in two dispersing bands at LT. We monitored in detail the intensity at the Fermi energy, both at room temperature (RT) and LT, in different points of the surface Brillouin zone. While there is an overall intensity decrease at LT, the effect is more pronounced at 1/2@GAMMA@K, suggesting that the LT phase is indeed metallic. The role of correlation effects and FS nesting was also tested by measuring the dispersion of the surface features both at LT and RT. The evidences found support that nesting is not the driving force of the transition. However, the modifications observed in the LT electronic structure indicate a significant gain in electronic energy along the phase transition. These findings will be discussed in view of existing theoretical models. @FootnoteText@ @footnote 1@J.M. Carpinelli et al., Nature 381, 398 (1996). @footnote 2@A. Goldoni et al, Phys.Rev. B 55, 4109 (1997).

SS-ThP6 Adatom Pairing or Dimer Formation for Si on Ge(001)?, H.J.W. Zandvliet, E. Zoethout, University of Twente, The Netherlands; W. Wulfhekel, University of Twente, The Netherlands, Netherlands; G. Rosenfeld, B. Poelsema, University of Twente, The Netherlands

The early stages of room temperature growth of Si on Ge(001) have been studied with Scanning Tunneling Microscopy. The smallest observed entity is a cluster containing two Si atoms. The two atom clusters residing on top of the substrate dimer rows are dimers. These on top dimers exhibit a rotational mode and diffuse preferential along the substrate rows with activation barriers of 0.7 eV and 0.86 eV, respectively. Using dual bias imaging we show that the two-atom clusters that are positioned in trough positions are ordinary dimers too rather than adatom paired units. These "trough" dimers occasionally hop to an on top position and vice versa providing a pathway for diffusion across the substrate dimer rows.

SS-ThP7 Step Fluctuations on Vicinal Si(113), K. Sudoh, T. Yoshinobu, H. Iwasaki, Osaka University, Japan; E.D. Williams, University of Maryland The properties of steps play an important role in the description of dynamics of processes such as faceting and crystal growth. The vicinal surfaces of Si(113) are a model system for studying the evolution of steps into stable facets involving step-step attractions.@footnote 1@ In this paper, we investigate quantitatively the fluctuation properties of steps relevant to step coalescence using scanning tunneling microscopy (STM) on a Si(113) surface miscut along a low symmetry azimuth. In local thermal equilibrium at 710 °C, which is near the faceting transition temperature, coexistence of single, double, triple, and quadruple steps has been observed. To determine the dependence of the step stiffness on step height, we have measured the step-correlation function@footnote 2@ for the steps with different heights from STM images. This result shows that the step stiffness is proportional to the step height. This behavior can be qualitatively understood in terms of a terrace-step-kink (TSK) model which includes a short range step-step attraction. Performing Monte Carlo calculations, we have found that the linear dependence of the step stiffness on step height is expected only near the faceting temperature where unbinding of steps becomes facile. The high resolution STM images of the edge of triple and quadruple-steps evidently reveal significant unbinding of steps, in agreement with the prediction. @FootnoteText@ @footnote 1@S. Song and S. G. J. Mochrie, Phys. Rev. B51, 10068 (1995) @footnote 2@N. C. Bartelt, T. L. Einstein, and E. D. Williams, Surf. Sci. 273, 308 (1992)

SS-ThP8 Control of Atomic Step Arrangements on a Patterned Si(111) Substrate Through Molecular-Beam Epitaxy, *H. Omi, T. Ogino,* NTT, Basic Research Labs, Japan

Atomic steps on a surface have great potential to act as templates for nanostructure formation. Therefore, control of step arrangement is critical for positioning these nanostructures on a wafer-scale. In our previous study,@footnote 1@ we have focussed on step motions on a patterned Si(111) surface during high temperature annealing and found that regular atomic step bands are formed on the surface. In this presentation, we show that atomic step arrangement can also be designed by step-flow growth on a patterned Si(111) surface using molecular-beam epitaxy. We used a Si(111) wafer, miscut by 1.5 ° to the direction, 7 ° rotated from the [1 1 -2] direction, on which periodic mesa and trench patterns were fabricated by standard Si process. These patterns are aligned along the direction, 7 ° rotated from the [1 1 -2]. The pattern sizes are 1 - 10 μm wide and 1 um deep. By the introduction of such boundaries on the Si(111) surface, step-flow speed can be changed. This is because, concentration of adsorbed atoms on the restricted surface will be modulated by the presence of boundaries. In fact, we obtained particular step patterns related to the step-flow speed modulation. On a surface of 1 μ m wide mesa, for instance, steps become curved and projected towards the [-1 -1 2] direction by high temperature annealing before the Si deposition. These steps evolve into arrowhead-like shape with increasing Si layer thickness. These step arrowheads point towards the [1 1 -2] direction at an arrow angle of 60 °, and therefore suggest that they are composed of [-1 -1 2] type steps. The above results demonstrate that the orientation of steps on a Si(111) surface can be regulated by introducing boundary conditions into the step-flow growth. The step-flow growth on a patterned substrate offers the possibility to design step arrangements on a wafer scale. @FootnoteText@ @footnote 1@ T. Ogino, H. Hibino, and Y. Homma, Appl. Surf. Sci. 117/118, 642 (1997).

SS-ThP9 The Atomistics of Silicide Formation on Si(111) and Si(113) Studied with High Temperature STM, V. Dorna, P. Kohstall, U.K. Koehler, Ruhr-Universitaet Bochum, Germany

Basic steps of the nucleation of iron silicide on Si(111) and Si(113) during gas phase deposition (CVD) were investigated by high temperature STM directly during growth up to 650°C. The formation of ordered silicides above 300°C is directly observed in form of STM-"movies". When solely iron is deposited via Fe(CO)@sub 5@ as a gaseous source, silicon from the substrate reacts to form the silicide. On Si(111) always three different types of islands nucleate even in the very first stage. The dominating @gamma@-silicide type is surrounded by holes in the silicon substrate. In a quantitative analysis the stochiometry of the silicide nuclei was found to be temperature dependent, whereas the sticking behavior of the precursor gas is not activated. At higher temperatures the fraction of a second island-type increases, which shows an only weakly ordered surface periodicity pointing to an @alpha@-silicide. A reversible transition between both phases can be forced by a surplus of Si or Fe. The third island type is implanted into the substrate surface. When Fe and Si using Si@sub

2@H@sub 6@ are co-deposited, a gas composition for a stochiometric silicide growth is found which is in agreement with separately determined sticking coefficients on the substrate. With increasing coverage all different phases transform into @gamma@-silicide, but no layer by layer growth could be archived on Si(111). On Si(113), on the other hand, the 3D-growth seems to be suppressed in the case of the co-deposition, which may be a chance to achieve layer by layer growth.

SS-ThP10 Reconstructions of Ag on High-Index Silicon Surfaces, S.R. Blankenship, H.H. Song, A.A. Baski, J.A. Carlisle, Virginia Commonwealth University

Si(5 5 12), a recently discovered, stable high-index surface of silicon, may offer a superior template for the growth of 1D metallic structures. This surface predominately consists of long pi-bonded Si rows. We are using Reflection High-Energy Electron Diffraction (RHEED) to determine the surface phase diagram of Ag on this surface, and the related surface of Si(337). Each of these surfaces exhibit a very sharp (2x1) reconstruction after flashing to ~1250°C. The growth of Ag on these surfaces is split into two distinct regimes. For growth at low coverages (@THETA@0.4 ML) and temperatures (450°C

SS-ThP11 Structure Determination of Si(111)/Sb-(@sr@3x@sr@3)R30@degree@ using Photoelectron Diffraction Direct Methods, M. Martin, LURE, Centre Universitaire Paris Sud and ICMM, France; H. Ascolani, Centro Atomico Bariloche, Argentina, Argentine; N. Franco, J. Avila, M.C. Asensio, LURE, Centre Universitaire Paris Sud and ICMM, France

The determination of the local adsorption structure of absorbed atoms and molecules on single-crystal substrates is a key prerequisite for understanding the electronic and chemical properties of surfaces. Most of the fragments or molecular adsorbates generally present a well defined local order, although, do not form the long-range ordered structures required for conventional LEED studies. One technique applicable to such problems is Photoelectron Diffraction, where the intensity of a core level peak is recorded as a function of the kinetic energy or the emission angle. The spectra measured in this way show intensity modulations which can be strictly correlated with the local structural environment of the atomic emitter. Recently, new direct methods based on energy scan mode have been developed relying on the high scattering factor for 180° backscattering, at low energies. This "backscattering searching" approach requires the measurement of scanned energy spectra at several angles along the high symmetry direction. In the present communication, we report the results of different direct methods for the Si(111)-Sb (@sr@3x@sr@3) structure. The limitations and advantages of each method are analized and the results are contrasted with the final structure obtained by a full multiple scattering trial-and-error analysis.

SS-ThP12 Photoelectron Diffraction Intensity Calculation by Using Tensor LEED Theory, S. Omori, Y. Nihei, University of Tokyo, Japan

Low-energy photoelectron diffraction (PED) by using synchrotron radiation (SR) has become more and more important for determining surface structures. In particular, PED has the advantage that surfaces having no two-dimensional translation symmetry such as initial-stage adsorption systems can be analyzed provided that the atomic arrangements around photoelectron emitters are symmetric. Since low-energy PED is extremely sensitive to surface structures, multiple structural parameters are usually to be determined by fitting experiment and theory. However, since multiple-scattering effects are important at low photoelectron energies, the structural analysis might be very time-consuming. In this study, we tried to incorporate the tensor LEED (TLEED) theory, a powerful perturbative approach to LEED intensity calculation,@footnote 1@ into the PED formalism and to develop a high-speed trial-and-error method for the structure determination with PED. Since scattering processes that occur in solid surfaces are almost the same for PED and LEED, the formulation of tensor PED is straight-forward. The change in the transition matrix of an atom brought about by its displacement can be calculated by the same method as in TLEED. Once the quantities related to the reference structure, namely the amplitudes of spherical waves incoming to and outgoing from the displaced atom are calculated in the process of multiple-scattering cluster (MSC) calculation for the reference structure and are stored in a hard disk, it is easy to evaluate the changes in the diffraction wave field for many trial structures. We demonstrate the efficiency and accuracy of this method. @FootnoteText@ @footnote 1@P. J. Rous et al., Phys. Rev. Lett. 57 (1986) 2951.

SS-ThP13 The Surface Structure Determination of @alpha@-Fe@sub 2@O@sub 3@(0001) by Low-Energy X-Ray Photoelectron Diffraction, S. Thevuthasan, Y.J. Kim, S.A. Chambers, Pacific Northwest National Laboratory; J. Morais, R. Denecke, C.S. Fadley, Lawrence Berkeley National Laboratory; P. Liu, T. Kendelewicz, D.E. Brown Jr., Stanford University

The structure and composition of oxide surfaces strongly influence the chemical and mechanical properities of these materials. As such, there is a growing interest of determining surface termination, reconstruction and relaxation on these surfaces. Recent theoretical work by Wasserman et. al [1] have shown that hematite(@alpha@-Fe@sub 2@O@sub 3@(0001)) surface has a single Fe layer termination with relaxations in the first four planes of -49%, -3%, -41%, and 21% of the bulk values respectively. We recently performed x-ray photoelectron diffraction measurements at Advanced Light Source on a clean, epitaxially grown Fe@sub 2@O@sub 3@(0001)/Al@sub 2@O@sub 3@(0001). A photon energy of 400 eV (Fe 3p E@sub kin@ = 344 eV) was used to collect several Fe 3p azimuthal scans at different take off angles. The experimental data were compared to the theoretical simulations using single and multiple scattering calculations with trial geometries. R-factors were calculated and minimized to obtain the optimum geometry. The surface appears to be Fe-terminated and the first four layer spacing are -41%, +18%, -8%, and 47% of the associated bulk values, respectively. @FootnoteText@ Work supported by the U.S. Department of Energy (DOE), Office of Basic Energy Sciences and Biological and Environmental Research Environmental Management ScienceProgram

SS-ThP15 Barrier-Height Imaging of Defects on the Si(001) 2x1 Surface, S. Kurokawa, A. Sakai, Kyoto University, Japan

The C-type defect on the Si(001) 2x1 surface is known to be an active site in Fermi level pinning and also in the initial oxidation of Si(001). In spite of its practical importance, the atomic structure of this defect has not completely understood yet. Controversies also exist on the tunneling barrier height at the C defect. Hamers and Köhler@footnote 1@ found that the barrier height decreases around the defect but increases just above the defect site. On the other hand, Ukraintsev et al.@footnote 2@ reported no such changes in the barrier height at and around the C defect. We have performed the STM barrier-height imaging on clean and oxygen-adsorbed Si(001) 2x1 surfaces and investigated the barrier height at various surface defects. We find that the apparent barrier height at the C defect closely follows the STM corrugation profile: the barrier height increases at the defect site under positive sample bias, but shows no depression around the defect. Our finding is consistent with the relation between barrier-height and STM images but not in agreement with Hamers and Köhler.@footnote 1@ Upon exposure to 1L of oxygen, preliminary barrier-height measurements show that the apparent barrier height at the C defect site appears to be reduced. The effects of oxygen adsorption on other surface defects will also be presented. @FootnoteText@ @footnote 1@R. J. Hamers and U. K. Köhler, J.Vac.Sci.Technol. A7, 2854 (1989). @footnote 2@V. A. Ukraintsev, Z. Dohnalek, and J. T. Yates. Jr., Surf. Sci. 388, 132 (1997).

SS-ThP16 Disappearance of Element-Specific Kikuchi Bands from Fluoride Surfaces, S. Omori, Y. Nihei, University of Tokyo, Japan

We will discuss X-ray photoelectron diffraction (XPED) from fluoride surfaces with different crystal structures, namely SrF@sub 2@ (fluorite structure) and MgF@sub 2@ (rutile structure). Scanned-angle XPED patterns of substrate emission over a large solid angle consist of strong forward-scattering peaks along high-density crystal axes, surrounded by first-order interference fringes, and Kikuchi bands along the projections of low-index crystal planes. In contrast to Kikuchi electron diffraction, Kikuchi bands in XPED patterns originate from a specific element in a sample. It has been shown that such element-specific Kikuchi bands have the following characteristics;@footnote 1@ (1) There is a site-specific extinction rule, in addition to the ordinary one that the Fourier coefficients of the crystal potential are zero. (2) The intensity of Kikuchi bands strongly depend both on those coefficients and on photoelectron-emitter sites. (3) Dark Kikuchi bands of depressed int! !! ensity can occur if photoelectron emitters satisfy a certain condition. In this presentation, we mainly concentrate on such element-specific Kikuchi-band effects. It was found that a set of (111) bands disappear in the Mg 2s pattern for MgF@sub 2@ and in the F1s pattern for SrF@sub 2@, although they were clearly observed in the pattern for the other element of each sample. We show that these element-specific effects on the extinction of Kikuchi bands occur by different mechanisms and that such apparently complex intensity properties can be well understood on the basis of three principles described above and can be well reproduced by multiple-scattering cluster

(MSC) calculations. @FootnoteText@ @footnote 1@ S. Omori et al., Jpn. J. Appl. Phys. 36 (1997) L1689.

SS-ThP17 Anisotropic Electron Scattering from Point Defects on Graphite at Low Temperature, K.F. Kelly, Rice University; J.G. Kushmerick, H.P. Rust, The Pennsylvania State University; N.J. Halas, Rice University; P.S. Weiss, The Pennsylvania State University

A low temperature ultrahigh vacuum scanning tunneling microscope was used to image threefold symmetric electron scattering from point defects in the graphite surface. Such defects were theoretically predicted,@footnote 1@ but had only previously been observed with C@sub 60@-functionalized tips at room temperature.@footnote 2@ Cryogenic temperatures sharpen the Fermi distribution enabling the observation of electron scattering. The energy dependence of the scattering was mapped by spectroscopic imaging and acquiring complete current-voltage curves at specific positions with respect to the scattering center. @FootnoteText@ @footnote 1@H. A. Mizes and J. S. Foster, Science 244, 559 (1989). @footnote 2@K. F. Kelly, D. Sarkar, G. D. Hale, N. J. Halas, Science 273, 1371 (1996).

SS-ThP18 Vacancy Creation as the Rate Limiting Step in Halogen Etching of Si(100)-2x1, K. Nakayama, University of Minnesota; C.M. Aldao, Universidad Nacional de Mar del Plata-CONICET, Argentina; J.H. Weaver, University of Minnesota

We have studied the etching on Si(100)-2x1 using scanning tunneling microscopy. Surfaces exposed to Cl@sub 2@ or Br@sub 2@ are etched at elevated temperature via the thermal activation reaction 2SiX(a) <--> SiX@sub 2@(a) + Si(a), where SiX@sub 2@(a) is a volatile molecule, Si(a) is a bystander Si atom, and X = Cl or Br. Formation of SiX@sub 2@(a) breaks the dimer @sigma@-bond and leaves the destabilized bystander with two dangling bonds. Conventional wisdom would indicate that SiX@sub 2@ desorption is the rate-limiting step. Instead, we show that the rate limiting step occurs when the bystander breaks away and moves onto the terrace. Thus, the de-excitation pathway to 2SiX(a) is eliminated. This increases the overall probability for SiX@sub 2@ desorption. We show that the rate of etching increases with halogen concentration until ~0.8 ML. It is reduced at higher coverage as the adsorbates block the escape of the bystander onto the terrace. We discuss the consequences and examine the post-etch surface morphology.

SS-ThP19 Growth of Ultrathin Mn Films on W(110), M. Bode, M. Hennefarth, M. Getzlaff, R. Wiesendanger, University of Hamburg, Germany

At room temperature bulk Manganese (Mn) exhibits complicated cubic structures with large unit cells. Simple crystallographic structures like fcc @gamma@- and the bcc @delta@-Mn are high temperature phases. However, it is well known that thin solid films can be stabilized on appropriate substrates in crystalline symmetries and lattice constants that are far from those of the corresponding bulk material. We have studied the growth of Mn on W(110)-substrates by means of STM and LEED. With our home-build MBE-STM@footnote 1@ we obtained growth sequences of particular microscopic locations. Up to a coverage of 0.5ML the nucleation of first monolayer islands which are elongated along the [110]-direction could be observed. The nucleation of second monolayer patches occurs before the completion of the first ML. We found that up to a total coverage of 2 monolayers Mn grows pseudomorphically on W(110), i.e. in the bcc @delta@-phase and strained by approximately 10%, as indicated by the absence of satellite spots in the LEED-pattern. If the total amount of deposited material exceeds 2ML we observed the evolution of rectangular islands with a minimum height of 5ML. This coincides with an increasing diffuse background in the LEED-pattern. Further deposition leads to a very rough surface morphology. @FootnoteText@ @footnote 1@ Ch. Witt, U. Mick, M. Bode, and R. Wiesendanger, Rev. Sci. Instrum. 68, 1455 (1997).

SS-ThP20 Electronic States and Structural Characterization in Single-Crystal Fe-Ni-O Alloy Thin Films Grown by Molecular Beam Epitaxy, *C.L. Chang*, Tamkang University, Taiwan; *G. Chern*, Chung-Cheng University, Taiwan; *C.L. Chen*, *H.H. Hsieh*, *W.F. Pong*, Tamkang University, Taiwan; *T.C. Leung*, Chung-Cheng University, Taiwan

Stimulated by the recent success of the research on epitaxial Fe@sub 3@O@sub 4@ and NiO thin films on MgO(001), we extend our study to the growth of a series of alloy Fe-Ni-O thin films with various Fe/Ni concentration ratio by molecular beam epitaxy. Total of 9 samples, around 500 Å thick, are fabricated including Fe@sub 3@O@sub 4@, NiO and Fe@sub x@Ni@sub 1-x@O@sub y@ (x=0.15, 0.3, 0.35, 0.56, 0.65, 0.71). These films are expected to show a structural crossover from spinel

to rocksalt structure and to show an associated change on valance states of Fe and Ni ions while x varies from 0 to 1. After analyzed by in-situ reflection high energy electron diffraction (RHEED), ex-situ x-ray diffraction, and x-ray absorption spectroscopy (XAS). It is observed that the crystal structure of all the alloy Fe@sub x@Ni@sub 1-x@O@sub y@ films resembles that of the spinel Fe@sub 3@O@sub 4@. The lattice spacing along the perpendicular direction as a function of x shows a minimum at x=0.5 instead of a linear variation indicating that the structures are different from a bulk ferrite Fe@sub 2@NiO@sub 4@-like phase. The distribution of the cations in Fe@sub x@Ni@sub 1-x@O@sub y@ system was studied by Fe and Ni L@sub 2,3@ XAS edge shapes, which are sensitive to the structural symmetry of the sites of the absorbing atoms. The results are qualitatively consistent with the x-ray observations. For x0.5 the excessive Ni ions occupy the Fe@super 3+@ sites of tetrahedral and octahedral symmetry up to the x value 0.71. The mechanism of forming the metastable phase and its implication on the magnetic properties of these Fe-Ni-O films will also be discussed. This work is supported by National Science Council of R. O. C. under grands NSC87-2613-M-032-001 and NSC87-2112-M-194-009

SS-ThP21 Field Desorption of Gallium from Liquid Metal Ion Source Studied by Back Scattered Electron Scanning Electron Microscopy, H. *Kimata*, Y. *Kondo*, ERATO, Japan Science and Tech. Corp., Japan; K. *Takayanagi*, Tokyo Institute of Technology, Japan

Field desorption of gallium metal from a home-made liquid metal ion source (LMIS) was studied in a scanning electron microscope (SEM). The LMIS has a needle and a reservoir filled with the liquid gallium and a filament. The needle apex is electrochemically sharpened, and the temperature of the LMIS was controlled. We found that the back scattered electron scanning electron microscopy (BSE-SEM) can give images of the needle apex during operation, the emission current being monitored simultaneously. The Taylor-cone and the change of the cone angle depending on the extraction voltage was observed by BSE-SEM. In case that the needle was grooved enough to supply liquid gallium towards the apex.@footnote 1@ the emission current vs. extraction voltage relations were found to fit well with the previous experimental results and theoretical predictions qualitatively. Rarely, the emission did not occur at the apex but the side of the needle, when the supply was limited by poor grooving on the needle. The critical voltage Vc was found to decrease linearly as the temperature T of the ion source increased from 200 to 450(°C). The Vc vs. T relations were analyzed to estimate temperature dependence of the surface tension of the liquid gallium, using the tip radius measured in SEM. The surface tension change like (0.8) - (3x10@super -4@)T, in accordance with the value given in a literature, (0.721) -(1.0x10@super -4@)T. Thus, BSE-SEM is useful to study the dynamics of LMIS. The present techniques are applied for testing a commercial LMIS because of large sample space in a SEM. @FootnoteText@ @footnote 1@A. Wagner and T. M. Hall, J. Vac. Sci. Technol. 16, 1871 (1980).

SS-ThP22 Stoichiometric Phase Transition and Facetting of Low Index Fe@sub 3@Si Surfaces, J. Schardt, W. Weiss, W. Meier, University of Erlangen-Nuernberg, Germany; C. Polop, P.L. de Andres, Universidad Autonoma de Madrid, Spain; U. Starke, K. Heinz, University of Erlangen-Nuernberg, Germany

In binary compounds segregation of one of the constituents is a frequently observed phenomenon. The respective changes of the stoichiometry are often not restricted to the topmost surface region. In this line, two phases of different stoichiometry can be stabilized on the (100), (110) and (111) surfaces of Fe@sub 3@Si bulk samples. On each surface the two phases can be reversibly transformed into each other by extended annealing cycles. The stability regions of each phase and the phase transition temperatures were determined using the stoichiometric information obtained from Auger electron spectroscopy (AES) and structural fingerprints gained from spot intensity spectra, I(E)-curves, of the lowenergy electron diffraction (LEED) pattern. These I(E)-curves were used for quantitative LEED structure analyses of each phase. In the low temperature regime (400° C) for all surfaces a D0@sub 3@ crystal structure can be confirmed. However, for preparation temperatures of around 600° C a restructuring of the surface region is observed. Segregation leads to a Si enrichment of the surface. This is accompanied by a structural transition to a CsCl crystal structure within the region accessible to the low-energy electrons. In addition, using LEED facetting of the (100) and (111) surfaces is observed with facets in (110) orientation which obviously is the energetically most stable plane of Fe@sub 3@Si.

SS-ThP23 Local Composition and Electronic and Optical Properties of Cr Oxide-Based Thin Films, J. Smith, D.A. Bonnell, The University of Pennsylvania, US; P. Carcia, R.H. French, E.I. Dupont de Nemours; X.F. Lin, The University of Pennsylvania

Oxynitride thin films are increasingly used to optimize resolution in optical lithography. Recently, a series of complex Cr-O-C-N films have been developed that allow simultaneous precise control over optical transmission, reflection, and phase shift. Subtle variations in optical properties appear to be related to small differences in O:C:N bond ratios across 100 nm films. To understand the mechanisms by which variations in anion coordination affect properties, the electronic structure near the Fermi level and local electrical conductivity measured by tunneling spectroscopy was related to optical properties in the end member compositions. Results from CrOx, CrCx, and CrNx this films, where x varies from 0.1 to 0.7, will be discussed in terms of the relationship between electronic and optical density and the consequence to optical properties.

SS-ThP24 Formation of a Bilayer Ordered Surface Alloy of Mn Thin Films, *W. Kim*, Seoul National University, Republic of Korea; *J. Seo*, Chodang University, Republic of Korea; *J.-S. Kim*, Sook-Myung Women's University, Republic of Korea; *S.-J. Oh*, Seoul National University, Republic of Korea We report a new type of surface alloy, the formation of a bilayer ordered

surface alloy of Mn thin films deposited on some transition metal (100) surfaces, from the results of Low-energy electron diffraction(LEED) I/V analyses. For Mn on Ag(100), very sharp and bright c(2x2) LEED pattern is observed with norminal 1 monolayer Mn deposited, and the experimental I/V curve is well fitted only by a model, a bilayer ordered surface alloy structure with little corrugation of Mn atom. Sudden disappearance of c(2x2) pattern is, however, observed on light annealing at 400K. By analyses on atomic compositions of each layer using averaged t-matrix approximation(ATA), we find out that vanishment of LEED superstructure is due to the segregation of Ag atoms. For the case of Mn on Pd(100), we achieve more improved fitting of the experimental I/V curves by employing a bilayer ordered surface alloy instead of the single layer ordered alloy model which was tried in the previous study of Tian et. al.@footnote 1@ However, unlike the Mn atoms deposited on Ag(100) surface, the topmost Mn atoms in this system are severely buckled out from the surface and its amount of corrugation is comparable to that of Mn/Cu(100) system. Thermodynamic property is also different: More clear c(2x2) LEED pattern is obtained after annealing. Mn 3s core level spectra of both systems show exchange splittings similar with that of bulk Mn, so magnetic effect on surface alloving is important in common with two cases. The distinctive characteristics of these two systems belonging to the same class of surface alloy, can be understood qualitatively, considering the differences in surface free energy and atomic size effect between Ag and Pd. @FootnoteText@ @footnote 1@ D. Tian, R.F. Lin, F. Jona, P.M. Marcus, Solid State Commun. Vol. 74, 1017(1990)

SS-ThP25 Surface Reconstruction and Charge Density Wave on ß-(BEDT-TTF)@sub 2@PF@sub 6@ Studied by Scanning Tunneling Microscopy, M. Ishida, K. Miyake, K. Hata, University of Tsukuba, Japan; T. Mori, Tokyo Institute of Technology, Japan; H. Shigekawa, University of Tsukuba, Japan ß-(BEDT-TTF)@sub 2@PF@sub 6@ is one of the quasi-one-dimensional organic conductors and is known to show metal-insulator transition at ~297 K with Charge Density Wave(CDW). STM/AFM study on this crystal revealed the characteristic properties of the molecular crystal surface for the first time. On the PF@sub 6@ surface, superstructure was formed by missing alternate molecular rows of PF@sub 6@. This is the first observation of the surface reconstruction of molecular crystal including a dractic change in the molecular arrangement.@footnote 1@ On the other hand, BEDT-TTF terminated surface induced molecular rearrangement with charge redistribution resulting in the symmetry breaking; formation of the twofold periodicity in the direction perpendicular to the one-dimensional conductive axis. The origin of these structures could be explained comprehensively by the compensation mechanism of the incomplete charge transfer on the polar surface.@footnote 2@ Furthermore, STM measurement was performed from 80K to room temperature to observe the CDW phase directly. In the low temperature range up to 280 K, it was difficult to observe detailed surface structure because of low conductivity owing to the CDW gap. In the temperature range from 280 K, however, long range modulations were observed and we concluded that the modulations reflect the CDW phase. @FootnoteText@ @footnote 1@M. Ishida, K. Hata, T. Mori, and H. Shigekawa, Phys. Rev. B 55, 6773 (1997). @footnote 2@M. Tsukada and T. Hoshino, J. Phys. Soc. Jpn. 51, 2562 (1982).

SS-ThP26 Structure of the Five-Fold Surface of Al@sub 70@Pd@sub 21@Mn@sub 9@, J. Ledieu, A. Munz, T. Parker, R. McGrath, University of Liverpool, United Kingdom; R.D. Diehl, Pennsylvania State University; D.W. Delaney, T.A. Lograsso, Iowa State University

Quasicrystals are bi- or tri-metallic alloys with long range orientational order and no short range translational order. Coatings of quasicrystals have low coefficients of friction and high resistance to wear,@footnote 1@ and hence the surface structure is of obvious interest. We have investigated the five-fold surface of the Al@sub 70@Pd@sub 21@Mn@sub 9@ quasicrystal using STM, LEED and AES. Surfaces annealed to 875 K showed excellent five-fold symmetric LEED patterns, and STM revealed disordered clumps of cluster-like protrusions 25±2 Å in diameter, similar to those observed for surfaces cleaved in vacuum.@footnote 2@ Higher resolution images showed these clusters were themselves composed of 2.5 Å diameter protrusions. Surfaces annealed to 1100 K showed sharp LEED patterns and atomically flat surfaces, in agreement with previous work.@footnote 3@ The data quality have allowed us to go beyond the previous analysis@footnote 3@ to examine structural features of the surface in detail. The most striking features are groups of protrusions forming fivefold star-shaped patterns. Threshold and pattern analysis of the images shows that the surface can be generated by tiling with pentagons using parallelograms to take up frustration. The parallelograms contain defects in the form of large protrusions, and gradients of the defect peaks were found to match angles present in the stereographic projection of the icosahedral group m35. Ratios of distances between the defect peaks and ratios of sequential step heights were found to equal the golden mean @tau@. Further analysis and adsorption experiments are being undertaken. @FootnoteText@ @footnote 1@S. L. Chang, W. B. Chin, C. M. Zhang, C. J. Jenks and P. A. Thiel, Surf. Sci. 337 (1995) 135; S. S. Kang, J. M. Dubois and V. J. Stebut, J. Mater. Res. 8 (1993) 2471. @footnote 2@Ph. Ebert, M. Feuerbacher, N. Tamura, M. Wollgarten, K. Urban, Phys. Rev. Lett. 77 (1996) 3827. @footnote 3@T. M. Schaub, D. E. Buergler, H. -J. Guentherodt, J. -B. Suck, Phys. Rev. Lett. 73 (1994) 1255.

SS-ThP27 Quantum-Size Effects on the Pattern Formation of Monatomic-Layer-High Metal Islands at Surfaces, K. Jin, University of Tennessee, Knoxville; G.D. Mahan, Univ. of Tennessee, Knoxville & Oak Ridge National Lab; H. Metiu, University of California, Santa Barbara; Z. Zhang, Oak Ridge National Laboratory

The quantum-size effects are shown to play a crucial role in defining pattern formation of metal island on surface.@footnote 1@ The energy in elongated needle-like growth is found to oscillate with the width of the needle, clearly demonstrating the existence of preferred needle widths. The energy of the square or rectangular islands varies periodically with the side length, predicting stability variations of the islands with different sizes. This work is supported by University of Tennessee, by Oak Ridge National Laboratory, managed by Lockheed Martin Energy Research Corporation for the U.S. Department of Energy under contract number DE-AC05-96OR22464 @FootnoteText@ @footnote 1@ K.-J. Jin, G. D. Mahan, H. Metiu, and Z. Y. Zhang, Phys. Rev. Lett. 80, 1026 (1998).

SS-ThP28 Finite-size Scaling Behavior of the Tracer Surface Diffusion Coefficient near a Second-order Phase Transition, F. Nieto, Universidad Nacional de San Luis, Argentina; A.A. Tarasenko, National Academy of Science of Ukraine, Ukraine; C. Uebing, Max-Planck-Institut fuer Eisenforschung, Germany

We investigate the finite-size scaling behavior of the tracer surface diffusion coefficient in the vicinity of a second order phase transition. For this purpose, we use a lattice gas model of repulsively interacting particles on a square lattice. For all lattice sizes L studied, the measured tracer surface diffusion coefficient, D@sub t@, is a smooth function, having an inflexion point at critical temperature. Its derivative, dD@sub t@/d(1/k@sub B@T), exhibits a cusp-like maximum which is (a) sharply pronounced and (b) converged to T@sub c@ for large lattice sizes. We have analyzed the finite-size behavior of D@sub t@ and obtained its critical exponent @sigma@=0.665±0.003.

SS-ThP29 Computer Simulation of the Au(111) @sr@3 x 22 Surface Reconstruction, *T.M. Trimble*, University of Maryland; *R.C. Cammarata*, Johns Hopkins University; *E.D. Williams*, University of Maryland; *K. Sieradzki*, Arizona State University

A computer simulation study of the Au(111) $@sq@3 \times 22$ surface reconstruction will be discussed. This reconstruction can be described as involving a uniaxial in-plane contraction of the top monolayer corresponding to a surface strain of about 4%, and has been observed to be the stable surface structure at low temperatures. The driving force for this reconstruction has been identified as the difference in the surface stress f and the surface free energy @gamma@ of the 1x1 surface, while the opposing force is owing to the free energy cost associated with the top monolayer losing atomic registry with underlying lattice. A simple continuum analysis gave the following stability criterion: a (111) fcc metal surface will undergo a reconstruction involving contraction of the top monolayer if the ratio (f - @gamma@)/µb exceeds a certain critical value of order 0.1, where μ is the shear modulus and b is the nearest neighbor distance. This criterion was tested with computer simulations that were conducted using the Johnson analytical embedded atom method (EAM) potential. Since the standard Johnson potential for Au leads to the result that the 1x1 surface is stable to reconstruction, modifications were made in values of some Johnson EAM input paramters in order to stabilize the reconstruction. It was found that although the resulting values of f and @gamma@ were somewhat lower than those obtained from first principles calculations, the driving force (f - @gamma@) obtained by the simulation and the first principle calculations were very close. Furthermore, the critical value of the stability parameter (f - @gamma@)/µb, inferred from results obtained from simulations of reconstructions with different surface strains, was found to be very close to that predicted by the continuum analysis. This work was supported by NSF through the University of Maryland MRSEC.

SS-ThP30 LEED Study of the Relaxation of Cu(211), *Th. Seyller*, *R.D. Diehl*, Pennsylvania State University; *F. Jona*, State University of New York, Stony Brook

A low-energy electron diffraction study of the vicinal Cu(211) surface has been carried out at 300 K. The experiments were carried out at normal incidence to the (211) planes and the calculations were carried out using the CHANGE program@footnote 1@ which is capable of calculating intensities for surface structures which have small interlayer spacings. The results indicate a large (15 percent) contraction of the top layer Cu atoms and essentially bulk spacings for deeper layers. The large contraction of the top layer agrees very well with a first principles calculation for Cu(211).@footnote 2@ However, the first-principles calculation as well as earlier embedded-atom model calculations@footnote 3@ predict large relaxations of the deeper layers as well. These discrepancies will be discussed in light of structure determinations for other vicinal surfaces. @FootnoteText@ @footnote 1@D. Jepsen, in "Determination of Surface Structure by LEED" edited by P.M. Marcus and F. Jona, Plenum Press 1984, p.17. @footnote 2@C.Y. Wei, Steven P. Lewis, E.J. Mele and Andrew M. Rappe, Phys. Rev. B 57 (1998) 10062. @footnote 3@S. Durukanoglu, A. Kara and T. S. Rahman, Phys. Rev. B 55 (1997) 13894.

SS-ThP31 Interlayer Diffusion Near Ledge Contacts: Comparison of Systems with Positive and Negative Schwoebel-Ehrlich Barriers, V. Shah, L. Yang, Iowa State University; T.L. Einstein, University of Maryland

We present molecular statics studies on the diffusion mechanisms near steps on fcc (111) surfaces. We use the Molecular Dynamics/Monte Carlo-Corrected Effective Medium (MD/MC-CEM) interatomic potential, which has been applied to the study of the Schwoebel-Ehrlich (SE) barriers for single atom diffusion towards a single descending step on Ag, Cu, Au, Pd, Ni, and Pt [Y. Li and A. E. DePristo, Surf. Sci. 351, 189 (1996)]. Among these six transition metals, the MD/MC-CEM potential predicts that Cu and Pd, respectively, have the highest (137 meV) and lowest (-4 meV) SE barriers for interlayer diffusion, via the exchange mechanism at the B-type step. In the present study, we focus on the change in the SE barrier for single- and multi-atom diffusion at descending step edge contacts for two model systems that have positive (Cu) and slightly negative (Pd) SE barriers for atomic diffusion at a single step. We also track the potential surface as an atom approaches corners while diffusing along island edges and as it diffuses away from the step edge on an island plateau. Our results on the behavior of mass transport near ledge contacts will be discussed in the light of recent experimental observations [M. Giesen et al., Phys. Rev. Lett. 80, 552 (1998)]. Two of us (VS and LY) would like to thank members of the Department of Chemistry and the surface physics group at the University of Maryland for their hospitality during our visit there. TLE was supported by NSF-MRSEC at U. of Md.

SS-ThP32 Scanning Tunneling Spectroscopy and X-ray Photoemission Spectroscopy Studies of Thin Films of WO3 and In2O3, *S. Santucci, L. Lozzi, L. Odorisio, M. Passacantando, C. Cantalini,* Università dell'Aquila, Italy

p-n junction between p-Si and n-type semiconductor oxides like WO3 and In2O3 have been fabricated by thermal evaporation in high vacuum of pure powders onto p-doped Si(100) and submitted to anneal at different temperatures up to 450°C at different times. The rectifying properties of

the films have been studied by using the Scanning Tunneling Spectroscopy (STS) technique in air and using Cr-Au contacts on the etched surface of silicon and on the deposited films respectively. I-V characteristics have been measured for the films in the presence of NOx gas carried in a flux of dry air. The surface morphology of the deposited films with different annealing temperatures have been studied by Atomic Force Microscopy (AFM) where we have observed a regular rearrangement of the surface with a globular aspect for the In2O3 deposits whereas for WO3 films it showed a more flat and regular surface. X-ray Photoelectron spectroscopy (XPS) has been employed to study the composition of the deposited films and an ion beam depth profile technique to study the interface formation with the silicon substrate. n-type behavior of the films which is due to the oxygen deficiency has been observed by studying the valence band spectra of the films. A comparison with the Density Of States obtained by calculating the (dI/dV)/(I/V) of the I(V) curves detected by the STS technique has been also performed.

SS-ThP33 Atomic Force Microscopy Examination of the Evolution of the Surface Morphology of Bi@sub 4@Ti@sub 3@O@sub 12@ Grown by Molecular Beam Epitaxy, G.W. Brown, M.E. Hawley, Los Alamos National

Laboratory; C.D. Theis, J. Yeh, D.G. Schlom, Pennsylvania State University Bi@sub 4@Ti@sub 3@O@sub 12@ is a candidate material for use in electro-optic devices and non-volatile ferroelectric-based memories. In these applications, obtaining the desired electronic or optical properties depends on the ability to deposit very smooth films. We have examined the molecular beam epitaxial nucleation and growth of these films on SrTiO@sub 3@ with ex-situ atomic force microscopy (AFM) to observe the thickness dependence of the surface morphology. From the AFM data we obtain the direct, real space surface morphology, the RMS surface roughness as a function of thickness, the amount of material present in the growing layers, and the height difference correlation function of the surface. Bi@sub 4@Ti@sub 3@O@sub 12@ growth begins with the nucleation of a layer that is 1/4 unit cell thick followed by growth of 1/2 unit cell thick layers. A transition to multilayer island (3-dimensional) growth occurs somewhere between deposition of 25 % of the second layer and the completion of the third layer. This implies that the film grows in a Stranski-Krastonov mode with a critical thickness between 0.325 and 1.250 monolayers. After 3-dimensional growth begins, the surface morphology can be described with the dynamic scaling hypothesis (DSH).@footnote 1,2@ The DSH scaling exponents, extracted from the AFM images, are compared to other thin film growth systems and should provide checks for future models or simulations of Bi@sub 4@Ti@sub 3@O@sub 12@ growth. We observe an interesting thickness dependence of one of the scaling exponents which may be related to the stress relief involved in the S-K growth mode. Possible models for the stress relief will be discussed. Finally, results of deposition on substrates providing different lattice mismatches will be shown and implications for the growth of thicker, smooth films will be discussed. @FootnoteText@ @footnote 1@F. Family and T. Viscek, J. Phys. A: Math. Gen. 18, L75 (1985). @footnote 2@J. Lapujoulade, Surf. Sci. Rep. 20, 191 (1994).

SS-ThP34 AES-LEED Study of the Growth Mode of Ag on Au (111),(311) and (554) Single Crystal Surfaces, V.F.S. Rooryck, C. Buess-Herman, Universite Libre de Bruxelles, Belgium; G.A. Attard, University of Wales, United Kingdom; F.A.B. Reniers, Universite Libre de Bruxelles, Belgium

The growth mode of silver onto gold substrates has been the subject of many controversies. The energetics and lattice misfit between gold and silver seems to favor a layer-by-layer mode, confirmed by some studies, while others reported a Stransky-Krastanov mode. The deposition method (electrodeposition, UHV deposition), the analysis technique and the surface structure could be responsible for these different results. We have undertaken a LEED-AES study of the deposition of thermally evaporated silver onto gold single crystal surfaces. The Au (111), (311) and (554), with different atomic roughness were investigated. The deposition mode was determined from the intensity versus time evolution of the Auger lines of gold (69 eV) and silver (351-356 eV). The Gallon model was used to fit the experimental data to theoretical simulations. The most recent values of IMFP and AL were introduced in the model. Following the results, the Stransky-Krastanov growth occurs, but 2 or 3 layers are deposited before the island growth begins. The evolution of the surface structure during silver deposition was simultaneously followed by LEED. We showed that the reconstruction of thermodynamically equilibrated pure gold surfaces was progressively removed by silver adsorption, apparently starting at half a monolayer coverage. The possibility of the formation of an interfacial alloy is investigated, and a comparison is made with the results that we obtained for the electrodeposition of silver on the same gold surfaces.

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