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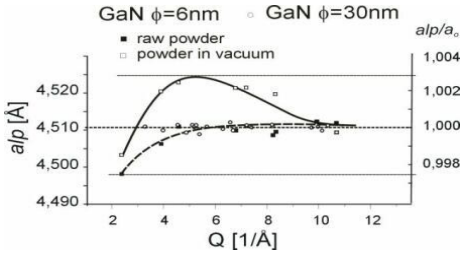
EFFECT OF THE CHEMICAL STATE OF THE SURFACE ON THE RELAXATION OF THE SURFACE SHELL ATOMS IN SiC AND GaN NANOCRYSTALS

B.F. Palosz[1] E. Grzanka[1,2] S. Gierlotka[1] S. Stelmakh[1] R. Pielaszek[1,2] U. Bismayer[3] H.-P. Weber[4] W. Palosz[5] J.F. Janik[6]

[1]High Presure Research Center of Polish Academy of Sciences 'Unipress' Sokolowska 29/37 WARSAW 01-142 POLAND [2]Institute of Experimental Physics, Warsaw University, ul.Hoza 69 , 00 681 Warsaw, Poland [3]Mineral-Petrographisches Institut, Uni Hamburg, Grindelalle 48, D-20146 Hamburg, Germany [4]SNBL at ESRF, BP 220, Av des Martyrs, F-38043 Grenoble, France [5]USRA/NASA-Marshall Space Flight Center, Huntsville, Alabama 35812, USA [6]University of Mining and Metallurgy, al.Mickiewicza 30, 30-059 Cracow, Poland

The effect of the chemical state of the surface of nanoparticles on the relaxation in the near-surface layer was examined using the concept of the apparent lattice parameter (alp) determined for different diffraction vectors Q. At low diffraction vectors the peak positions are affected mainly by the structure of the near-surface layer, while at high Q-values only the interior of the grain contributes to the diffraction pattern. Theoretical alp-Q relations were obtained from diffraction patterns calculated for models of nanocrystals with a strained surface. We studied nanocrystalline SiC and GaN with average crystallite size from 5 to 30 nm. Following the measurements of as synthesized powders we investigated powders annealed at 400°C under vacuum, and same powders wetted with water. A strong dependence of the experimental alp-Q plots on the grain size and purity was found. Evaluation of the strain at the surface shell was made by comparison of experimental alp-Q plots with those computed for the core-shell model. We estimated the thickness of the shell in SiC nanocrystals to be 4 – 6 Å, with the tensile strain of about 10%. In GaN, the shell thickness is approximately 7Å with the compressive strain in the range 10 - 15%. Annealing the powders at 400°C under vacuum, as well as wetting them with water leads to a strong change of the measured alp values, Fig.1. We interpret this effect as a reconstruction of the atomic structure of the surface with simultaneous decrease of the surface strain.



Keywords: NANOCRYSTALS, SiC, GaN

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SURFACE AND INTERFACE STRUCTURE BEAMLINE (BL13XU) AT SPring-8

O. Sakata[1] Y. Furukawa[1] S. Goto[1] T. Mochizuki[1] T. Uruga[1] K. Takeshita[1] H. Ohashi[1] T. Ohata[1] T. Matsushita[1] S. Takahashi[1] T. Ishikawa[2] K. Sumitani[3] T. Takahashi[3] M. Nakamura[4] M. Ito[4] A. Saito[5] T. Shimura[5] M. Takahashi[6]

[1]Japan Synchrotron Radiation Research Institute Materails Science Kouto 1-1-1, Mikazuki SAYO HYOGO 679-5198 JAPAN [2]Riken Harima-Institute [3]University of Tokyo [4]Keio University [5]Osaka University [6]Japan Atomic Energy Research Institute

Japan Synchrotron Radiation Research Institute has recently built a beamline (BL13XU) for investigating crystal structures of surfaces and interfaces in SPring-8. The light source is the standard SPring-8 in-vacuum undulator. The fundamental energy range is available from 18.9 to 5.5 keV. The beamline double crystal monochromator with an Si 111 reflection is cooled down with a liquid nitrogen chiller. The two mirrors (in a horizontal scattering geometry) are for rejecting harmonics of incident photons and for focusing an X-ray beam, having two stripes of a Rh and a Pt coating film. We first report some results of performance check of the beamline monochromator and mirrors; the results include photon flux densities (more than 4 x 10 to the 13th power photons /s / square mm measured with photon energies from 6 to 25 keV), stability examination of the photon flux densities, and focal conditions of the mirrors. Principal facilities are three ultra-high vacuum chambers (that will be coupled to an S2 + D2 diffractometer). The chambers are equipped with standard surface-structure-analysis apparatus and sample growth tools. Chamber 1 is suitable for wide-range-temperature (20-2000 K) measurements on a surface. Chamber 2 and 3 target determination of a semiconductor surface structure using X-ray scattering and X-ray standing waves, respectively. We second describe the designs of those chambers and introduce our first surface X-ray diffraction data obtained at 25 K in chamber 1.

Keywords: **BEAMLINE SURFACE DIFFRACTION ULTRAHIGH VACUUM CHAMBER**

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GaSb AND GaAs CHEMICAL POLISHING BY HF:H_2O_2:CITRIC ACID: H_2O

E. R. Rosendo[1] J. O. Olvera[1] T. D. Díaz[1] M. R. Rojas[2] F. de Anda[3]

[1]Icuap-Buap CIDS 14 Sur Y San Claudio PUEBLA PUEBLA 72570 MEXICO [2]CICATA-IPN, Unidad Puebla [3]IICO-UASLP

Results of morphology studies in GaSb and GaAs after chemical polishing based on HF:H_2O_2:Citric acid: H_2O are presented. The solution investigated was used with several HF concentrations (from 0.065 to 5.2 mol), H_2O_2 (1.28 to 3.23 mol) and citric acid ($C_6H_8O_7.H_2O$) concentration was maintained constant (1.3 mol) to obtain the etching rate. The etching temperature was varied between room temperature and 75 °C for the same chemical compounds concentration. The etching rate was obtained from optical measurements and influence of etching temperature on surface morphology was studied too.

Keywords: **SURFACE MORPHOLOGY, CHEMICAL POLISHING, ETCHING RATE**

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STRUCTURE OF LIQUID III-V COMPOUNDS UNDER PRESSURE

T. Hattori[1] K. Tsuji[1] Y. Katayama[2]

[1]Keio University, Faculty of Science and Technology Physics 3-14-1 Hiyoshi YOKOHAMA 223-8522 JAPAN [2]SPring8, JAERI

In order to elucidate the effects of the ionicity in chemical bonding on the structure and the high-pressure sequence in liquids, we have investigated the structure of liquid III-V compounds, such as GaSb and InSb, under pressure.
Experiments are performed by means of the energy-dispersive (EDX) and angler-dispersive X-ray diffraction methods (ADX) using a synchrotron radiation source in conjunction with the high-pressure apparatus. The EDX experiment using the double staged high-pressure apparatus enables us to reveal the averaged structure of the binary liquid at high pressures and temperatures up to about 20 GPa and 1400 K. The ADX experiment with a multi-channel collimator using the anomalous dispersion effect give information on the chemical short-range order under pressure.

The EDX results show that the local structure of liquid III-V compounds with both covalent and ionic bonding does not contract uniformly unlike simple liquid metals. The nearest neighbor distance does not change markedly in spite of the volume contraction. An analysis of the pair distribution function has shown that the local structures in liquids can be described by the distorted local structures of their high-pressure crystalline phases. The local structure is found to change from a low-coordinated state to the higher coordinated one under pressure. The effects of the ionicity in chemical bonding are discussed from the experimentally determined local structures for the liquids of GaSb and InSb.

Keywords: **LIQUID III-V COMPOUNDS HIGH PRESSURE SYNCHROTRON RADIATION**