11-Surfaces, Interfaces and Thin Films

PS-11.01.28 AN INVESTIGATION ON (100) MONOEPITAXIAL DIAMOND MONOCRYSTALLINE FILMS. By Z.M. Zhang, S.H.Li, Q.Y.Cai, H.M.Chen, X.C.He, D.L. Ling and S.J.Wang, Shanghai Jiao Tong Univ., Shanghai 200030, China. Z.W.Wu, S.S.Jiang, C.Z.Ge and N.B.Ming, Nanjing Univ., Nanjing 210008, China.

For diamond's excellent microelectrical properties and the rapid development of CVD techniques, the diamond high temperature semiconductor materials have been received increasing attention. In our work, we have obtained quite smooth homoepitaxial monocrystalline films deposited on (100) oriented HT-HP synthesized diamond by microwave PCVD method. The microwave frequency was 2.45 GHz, internal dimension of the quartz horizontal reaction tube was 35mm, the reaction gases were acetone and hydrogen, their flow rate was 100 SCCM and pressure 4-6.5 KPa. Microwave power was about 300W. For the characterization, SEM, Raman Spectroscopy, Double Crystal Diffraction and HEED were used. The results show that the acetone concentration directly affected the morphology and structure of the films, as well as the growth process. For lower concentration(0.9 Vol%), the growth pattern was essentially in line with the spiral dislocation growth mechanism, when raised to 1.7 Vol%, the epitaxial surface became more smooth, but the accumulation of defects in grown film led to the formation and growth of parasitic nuclei, and with higher concentration (2.6 Vol%), the cellular structure was locally formed. In addition, it is the advantage to enhance two-dimension growth and depress parasitic nucleation if argon was added, in this case, quite smooth monocrystal epitaxial layers formed.

PS-11.01.29 APPLICATION OF THE X-RAY STANDING WAVE TECHNIQUE TO ANALYSIS OF HETEROINTERFACES WITH MULTI-SITE OCCUPANCY

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The X-ray Standing Wave (XSW) technique is a powerful structural tool to study surfaces and interfaces. The intensity modulation of events excited by the electromagnetic field when Bragg diffraction takes place, allows the knowledge of both the modulus (named F) and the phase (named P) of an XSW structure factor relative to the excited atoms whose radiative decay is measured as a function of the Bragg angle. If the atoms under study occupy one well defined position relative to the diffracting planes, the measured P and F represent respectively the occupied position and the fraction of the total atoms which occupy that position, (1-P) being randomly distributed. However, often several sites are occupied at the same time and the resulting P and F are functions of the individual positions p_i's and the relative occupancies f_i's.

In this contribution we will present some examples of X-ray Standing Wave studies of metal/semiconductor and semiconductor/semiconductor heterointerfaces where multi-site occupancy took place. It will be shown that under appropriate assumptions the XSW can accurately describe the structure even when several sites are involved. This is the case, for example, of the alkali metal/Si interface. In the (111) orientation seven different sites have been considered. With two reflections and the assumption of a covalent bond the distribution of the alkali metal atoms into the seven sites have been determined.
Other examples will concern with III-V compounds and Si/Ge heterointerfaces.

PS-11.01.30 X-RAY STANDING WAVE STUDY OF THE FE/SI(111) INTERFACE. By B.Capelle*, A.Taccoen, J.-C. Boulliard, C. Malgrange, A.Lifchitz and J.-F. Pétroff, Laboratoire de Minéralogie-Cristallographie, Universités Paris VI et Paris VII, CNRS UA 09, 4, Place Jussieu, 75252 PARIS CEDEX 05, France.

At room temperature, α-iron grows on the (111) surfaces of silicon with the following epitaxial relations and with an abrupt interface:

$$Fe(111)//Si(111)$$
$$Fe[1\bar{1}0]//Si[1\bar{1}0]$$
$$Fe[11\bar{2}]//Si[11\bar{2}]$$

The growth of the first three monolayers (1ML=0,78 10^{14} at/cm^2) of iron on silicon has been studied by the X-Ray Standing Wave (XSW) method using the synchrotron radiation at the Laboratoire pour l'Utilisation du Rayonnement Electromagnétique (Orsay, France). Samples were elaborated in ultra high vacuum at room temperature. As XSW experiments occured at air, iron layers were covered by amorphous silicon to avoid any oxidation. For this study, new monolithic monochromators with four reflections (111, 220 and 004) were developed and inclined reflections (11$\bar{1}$, 220 and 004) have been used (Boulliard J.C, Capelle B., D. Ferret, A. Lifchitz, C. Malgrange, J.-F. Pétroff, A.Taccoen and Y.-L. Zheng, J.Phys.I France, 2, 1992, 1215-1232).

The following growth model fits well with the XSW experiments: iron atoms of the first layer adsorbate onto the T_4 sites with a contraction of the surface of the silicon (5 to 6%). Distance between iron atoms of the first layer and the nearest silicon atoms is between 2,30 and 2,40 Å. The three first layers grow with islands whose height is limited to three layers and which are completed before a fourth layer appears.

