07.1-11 INFLUENCE OF TEMPERATURE CHANGES ON SUCROSE CRYSTAL HABIT.

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One of the basic features of crystals is the anisotropy. The crystal growth rate is too anisotropic: in different crystallographic directions the growth rate is different. The object of this work was to determine the sucrose growth rate in different directions when the temperature changes for those solution concentrations where the mass growth rate is maximum (see /1/ and /2/).

The crystal growth tecnique is described in /3/ and /4/ with the particularity that to obtain the values of growth rate in each direction, the cystal were suspended perpendiculary to each principal direction: [100], [010] and [001].

We show the results related to growth rate in the direction [100], the slowest in the crystals. We observed that relative rates changes in different direction were not constant when the temperature changes; this means a change in the crystal habit when the temperature changes (see the following table).

T C \ Direction	[100]	[001]	[010]
35	1	1.22	2.46
40	1	1.08	2.22
45	1	1.07	2.16
50	1	1.10	2.16
55	1	1.13	2.19
60	1	1.16	2.21

We also observe that in extreme temperatures (35 C and 60 C) occurs a stretching in the axis b and c which is not due to any strange agent in the solution.

These results are important in sugar cooling crystallization when the solution temperature sweeps this temperature range.

/1/ Wong M., Ameneiro S., IX Seminario Cientifico del CENIC, 1985, CUBA.
/2/ Wong M., Alegret I, Memorias de la XI Conferencia de Quimica, Univ.Ote., 1985, CUBA.
/3/ Ameneiro S.,Rev.Cubana de Fisica,Vol. IV,1,1984,129-144.
/4/ Ameneiro S., XV Cong.Latinoamericano de Quimica, Puerto Rico, 1982, Libro Resumenes, pag.203.

07.1-12 DYNAMICAL OBSERVATIONS OF DENDRITIC GROWTH OF ALUMINUM-MAGNESIUM ALLOY SINGLE CRYSTALS BY REAL TIME X-RAY TOPOGRAPHY,

By T. Imura, T. Kobayashi* and N. Kawabe**, Department of Metallurgy, Faculty of Engineering, Nagoya University, Chikusa-ku, Nagoya 464 Japan, * Mitsubishi Heavy Industries Ltd., Hiroshima Technical Institute, Nishi-ku, Hiroshima 733 Japan, ** Sumitomo Electric Industry Ltd., Itami Works, Itami, Hyogo Prefecture 664 Japan.

Real time x-ray topography has been applied to study the dendritic growth of aluminum-magnesium alloy single crystals. Unidirectional melting and solidification processes of Al-Mg single crystals containing 0.5, 2.0 and 4.0 at%Mg were observed by real time x-ray topography, using 90 kW class high intensity rotating anode x-ray generator with TV-VTR imaging system. By this method, observations have been made on the following subjects: (1) sequential growth and morphologies of the dendrite arms during solidification as a function of growth rate. (2) morphological changes of dendrite arms as a function of Mg content. (3) morphological changes and solute redistribution during cooling and isothermal annealing after solidification. (4) observations of melting process of grown dendrite. The morphologies of the secondary and fourth arms varied with the change of growth rate. In the region of fast growth rate, primary and secondary arms have crossed at right angle, but they crossed at an acute angle in the region of slower rate. At the same growth rate of 150 μm/s, the angle between the primary and secondary arms became different due to Mg content,i.e. 90^{o} in Al-4.0 at%Mg alloy and 69^{o}in Al-0.5 at%Mg alloy, respectively. It was observed that a morphological change of dendrite arms during isothermal annealing occurs near the melting point in the first few minutes. Preferential growth directions of arms are not affected in dendrite growth by macroscopical growth direction. It should be noted that the solidification and melting processes are not exactly reversed.

07.2-1 EPITAXIAL GROWTH OF LEAD TIN SELENIDE FILMS ON (III) CALCIUM FLUORIDE AND ITS CHARACTERIZATION.

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Lead Tin Selenides are narrow energy gap semiconductors and so have potential uses for infrared applications. The epitaxial growth of them on alkalihalide and fluoride substrates has been accomplished by some methods(I)D.K. Hohnke and S.W.Kaiser,J.Appl.Phys.,I974,45,892-897. 2)M.Suzuki and T.Seki,Memoirs.Tohoku.Inst. Tech.,I985,Ser.I,I-7 etc.).
In this study, the epitaxial (III)films of $Pb_{I-x}Sn_xSe$ (x=0.06) were particularly grown on the polished and chemically etched (III) faces of CaF_2 substrates by molecular beam epitaxy method(MBE). We studied the influence of the growth conditions on the crystalline qualities and electrical properties of films.
The MBE growth system and procedure used here were similar to those described in ref.(2). The substrates were polished and chemically etched with diluted HF solution for 5-20 min. Prior to deposition, they were preheated at 500°C for 30 min. in a vacuum of $I0^{-6}$Pa. The binary compounds PbSe and SnSe were deposited simultaneously from each pyrolytic BN Knudsen cell. The temperature of each cell was controlled in order to obtain the selected PbSe/SnSe flux ratio. The growth temperature was in the range of 400-485°C and the growth rate was about 2 μm/h.
Crystalline qualities of films were evaluated with electron diffraction(ED), x-ray diffraction(XD) and scanning electron microscopy(SEM). Electrical properties were also investigated.

The results of ED and XD observations indicated that (III)oriented-epitaxial films could be grown on (III)CaF_2 substrates under the above growth conditions. The half-width of x-ray rocking curve of the film tended to decrease gradually with increasing the growth temperature(T_g). There was an optimum etching time(t_e) for the growth of smooth epitaxial films which had the smallest value of half-width and the best electrical properties. From the measurements with the van der Pauw method, the carrier concentration and the Hall mobility for an as-grown p-type film, under the optimum growth conditions(T_g=485°C, t_e=I5 min.), were 2xI0^{I7} cm^{-3}, I.5xI0^4 $cm^2/V\cdot s$ at 77K, respectively. The surface morphology of films was changed by the growth conditions. The SEM observations will also be presented.

07.2-2 DIFFRACTION STUDIES OF THE INTERFACE BETWEEN NICKEL FILMS AND SAPPHIRE SUBSTRATES.* By C.J. Sparks and G.E. Ice, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 USA and T. Habenschuss, Oak Ridge Associated Universities, Oak Ridge, Tennessee 37831 USA.

The structural perfection of epitaxial nickel films ~700 A thick grown on the (00·ℓ) or basal plane of heated sapphire (Al_2O_3) single crystals was studied with X-ray diffraction techniques. Rocking curve measurements on nickel films formed by vapor deposition showed that they increased in perfection as the temperature of the sapphire substrate approached 1400°C. The orientation relationship between the nickel film and the 00·ℓ deposition plane of sapphire is Ni(111)||Al_2O_3 and Ni<110>||Al_2O_3<11·0>. Warren-Averbach line shape analysis of the nickel film Bragg reflections was used to determine the particle size and strain. X-ray scattering from the interface between the nickel film and sapphire substrate was measured with synchrotron radiation. Measurements on the diffuse rods of X-ray scattering [see S.R. Andrews and R.A. Cowley, J. Phys. C 18, 6477 (1985) and I.K. Robinson, Phys. Rev. B 33(6), 3830 (1986)] normal to the interface gave information on the crystallography of the interface. Although the nearest nickel atom distances are 10.3% smaller than those of the close-packed direction in sapphire, the strain was accommodated at the interface rather than being distributed through the thickness of the nickel film. An analysis of the diffuse rods showed differences in the nature of the atomic roughness at the interface in comparison to studies on surfaces. Interpretation of the diffraction will be discussed.

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07.2-3 X-RAY DIFFRACTION OF CU-ZU ALLOY FILMS. By Y. Wang, D. Su and S. Zwei, Physics Department, Jilin University, China.

X-ray diffraction line analysis has been applied to some deformed metals as well as metallic films to get information about the dislocations and stacking faults in crystals. (Wang Yuming et al, J. Appl. Cryst., 1982, 15, 35 and Y. Wang et al, J. Materials Sci., 1985, 4, 635) The similar methods and procedures are performed in this report to find out the difference between the crystal defects in Cu-Zu 33% at. films vacuum-deposited on different substrates at different temperatures. Al polycrystals, Al monocrystals, Cu polycrystals and Si monocrystals are used as the substrates. The substrate temperatures vary from 423 to 623K. The thickness of all the films is around 1500nm. Two Mo boats are used to evaporate Cu and Zn separately but simultaneously. Results show that the dislocation density in general decreases with increasing substrate temperatures in most samples while the dislocation distribution varies in a complicated manner. As for the stacking faults no deformation faults can be detected while the twin faults decrease with increasing substrate temperatures. The substrate material affects the state of crystal defects greatly. Some of the results can be explained from the viewpoint of film formation mechanism satisfactorily.

07.2-4 STRUCTURAL AND ELECTRICAL PROPERTIES OF LASER IRRADIATED $Pb_{0.8}Sn_{0.2}Te$ THIN FILMS

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Laser processing of semiconductors have drawn considerable interest in recent years. $Pb_{0.8}Sn_{0.2}Te$ thin films of 0.8 µm thick were grown onto glass, mica and KCl substrates kept at 400°C using flash evaporation technique. As-grown films were irradiated with Nd:YAG laser (1.06 µm) pulses of various energy densities in the range 2-30mJ/cm . The pulse width was 20 nsec and pulse repitition rate was 1 pps.

X-ray diffraction,Transmission Electron Microscopy studies were made on all the films in order to understand the structural changes occurred due to laser irradiation. It has been observed that there is a significant decrease in defect density and increase in grain size with the increase in energy density of the laser pulses. D.C. conductivity and Hall coefficient studies were made in the temperature range 77-300K. An increase in both Hall coefficient and Hall mobility was observed due to laser irradiation. This increase in Hall coefficient can be due to the removal of excess tin present in the films thereby reducing the free carrier concentration. Increase in mobility is due to the decrease in defect density. Mobility-temperature data have been analysed in the light of defect and lattice scattering mechanisms.

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