GaCl will be shown. The analysis provides us useful information on the growth rate and the deposition composition. Next, HVPE growth of AlN and AlGaN will be described.

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Keywords: HVPE, Al-related nitrides, thermodynamic analysis

## MS.49.3

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### Fabrication of InN dot structures by droplet epitaxy using $NH_3$

Shigeya Naritsuka, Hiroaki Otsubo, Shoji Osaki, Takahiro Maruyama
Meijo University, Materials Science and Engineering, 1-501 Shiogamaguchi, Tenpaku-ku, Nagoya, Aichi, 468-8502, Japan, E-mail : narit@ccmfs.meijo-u.ac.jp

Quantum dots (QDs) of nitride semiconductors have been studied intensively because of their usefulness for device applications. Recently, we have fabricated GaN dots by droplet epitaxy. The droplet epitaxy requires neither any anti-surfactants nor the induction of surface strain for the formation of dot structures, which means the possibility of the QD formation on any substrates. In this study, we investigated fabrication of InN dots by droplet epitaxy with changing substrate temperature. After nitridation of Si(111) substrates, 1 ML of In was deposited on the substrates at 200 ℃ , leading to the formation of In droplets. Then, NH3 gas was irradiated on the In droplets for nitriding. AFM observation showed that the average density of dots of $1.1x10^{10}$ $cm^{-2}$ at 450℃ decreased as the temperature increased. Then, the density increased again up to $4.0x10^{10}$ $cm^{-2}$ at 570℃. However, no InN dot was observed on the sample nitridated at 600 ℃ . In 3d XPS spectra in Fig.1 indicates that In-N component was increased as the temperature increased while In-O component was decreased. Almost all In atoms was found to bind to N atoms at 570℃ by the formation of InN crystalline.

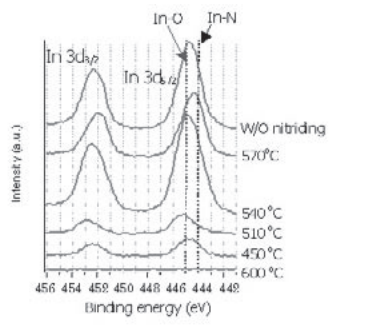


**Fig. 1** In 3d XPS spectra of InN dots grown by droplet epitaxy using $NH_3$.

Keywords: droplet epitaxy, indium nitiride, nitiriding

## MS.49.4

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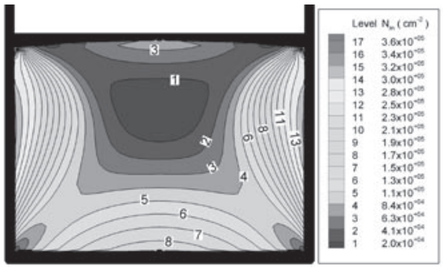
### Dislocation density in silicon ingot during a unidirectional solidification process

Xuejiang Chen[1], Satoshi Nakano[1], Lijun Liu[1,2], Koichi Kakimoto[1]
[1]Research Institute for Applied Mechanics, Kyushu University, 6-1 Kasuga-koen, Kasuga, Fukuoka 816-8580, Japan, Kasuga, Fukuoka, 816-8580, Japan, [2]National Engineering Research Center for Fluid Machinery and Compressors, School of Energy and Power Engineering, Xian Jiaotong University, 710049, China, E-mail : xjchen@riam.kyushu-u.ac.jp

Many dislocations and impurities in the silicon significantly affect the conversion efficiency of solar cells. Thermal stress is one of the major factors responsible for generation of dislocations during the unidirectional solidification process. Therefore, it is necessary to investigate the distribution of thermal stresses and dislocation density in the silicon ingot. A transient global model was used to obtain the solution of thermal field within the entire furnace. And then, based on transient global solution of heat transfer, computations were carried out to investigate the distribution of thermal stresses in silicon ingot. Finally, the dislocation density was also simulated by using Haasen-Alexander-Sumino model. The results on boundary condition analysis suggest that it is important to reduce the crucible constraint to grow a silicon ingot with low thermal stresses and dislocation density. The effects of solidification time on thermal stresses and dislocation density were also studied. The results reveal that long solidification time can reduce thermal stresses and dislocation density in a silicon ingot during the solidification process.



Keywords: solidification, stress, dislocations

## MS.49.5

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### AlN and GaN hetero epitaxy on Si substrate using activity modulation migration enhanced MBE

Tadashi Ohachi[1], Nobuhiko Yamabe[1], Hiroshi Shimomura[1], Takehiro Shimamura[1], Motoi Wada[1], Osamu Ariyada[2]
[1]Dosshisha University, Electrial Enginnering, 1-3, Miyakotani, Tatara, Kyotanebe, Kyoto, 610-0321, Japan, [2]Aios Inc. 3-2-20 Musashino Akishima, Tokyo 196-0021, Japan, E-mail : tohachi@mail.doshisha.ac.jp

In order to ontrol chemical and physical nitrogen activities two discharge modes of E and H modes[1] under a radio frequency inductive coupled (RF-ICP) discharge of nitrogen gas was investigated changing RF-power of nitrogen pressure. The chemical activities of disociated nitrogen atoms N+N* are much higher than those of excited nitrogen molecules $N_2$*. However $N_2$*has small chemical activity but large physical activity, which has large energy to enhance migration of Al or Ga atoms on a growing surface. The E and H modes of the ICP discharge are low brightness (LB) and high brightness (HB) discharges, respectively. Dissociated atomic nitrogen species are created by only the HB mode. The time sequence of the opening of the shutter of a Ga effusion cell was used for the trigger signal to operate the mode change operation of nitrogen ICP -RF discharge. An activity modulation migration enhanced epitaxial growth (AM-MEE) method is prpposed as an application of the MEE[2]. In order to grow the high quality layers on a Si substrate the AM-MEE growth method was performed. The sequence of the LB and HB discharges during the AM-MEE the nitrogen flux irradiation plays an important role to control the chemical activity of nitrogen. Activity control of nitrogen is also applied to a fabrication method of beta-Si3N4 epitaxial layer on Si(111) as an initial buffer layer for AlN film.

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