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height in lowest and the carrier density is highest among the other samples, mobility is not high. This result indicates that the mobility of SiO$_3$Ge$_7$ is not dominated by grain boundary scattering. We consider that the defects are easily introduced in SiGe grain due to low energy of SiGe bond and as a result the crystal quality is not high.

B0.23 High Power RF Diamond FETs with Low Resistive Source/Drain-Carrier DRAM Using Polycrystalline Si Ion Irradiation, Hideki Hata$^{1,2}$, Tatsuya Arata$^{1,2}$, Souichirou Meguma$^{1,2}$, Hiroshi Uemura$^{3,4}$, Domingo Ferrer$^{5}$, Takahiro Shinada$^{6}$, Iwao Ohdomari$^{7}$ and Hiroshi Kawasaki$^{1,2}$

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Semiconductor diamond exhibits superior material properties which are promising for future electronic devices, such as a wide band gap (5.5 eV), high breakdown field (>10 MV/cm), maximum thermal conductivity in materials (22 W/cm-K). We have developed RF diamond field effect transistors on hydrogen-terminated diamond surface, the sheet resistance of which is about 10 kΩ and achieved over 20 GHz cutoff frequency in 0.2 μm gate MOSFETs[1]. However, the hydrogen-terminated surface is sensitive to environmental changes, the conductivity easily decreases by increase of temperature, and there are troubles in operating stably in long-term. Furthermore, another problem in our RF diamond FET is high parasitic resistance due to the source-gate distance. The parasitic resistances result in low MAG(maximum available gain), fmax/ft of the RF MISFET is as low as 1.1-1.4[1]. This surface channel also restricts the maximum drain current because of very shallow carrier profiles of the surface channel. Realization for high performance RF diamond FETs, 1kΩ of sheet resistance is required. In order to meet these problems, the technique which fabricates the stable low resistive source-drain regions replaced with hydrogen-terminated surface is necessary. In this study, an FIR(Focused Ion Beam) apparatus with nickel metal ion source with accelerating voltage of 30 keV is used to realize low resistive Accelerating ions are locally irradiated on oxygen-terminated diamond surface which has 100μm of sheet resistance. In consequence, the diamond surface is locally modified to nickel carbide. In this results, when 1017 ions/cm2 are irradiated, sheet resistance decreases to 10kΩ which is correspondence to hydrogen-terminated conductivity, whereas 1015 ions/cm2 are irradiated, sheet resistance decreases to 1.3kΩ. Because Nickel carbide works as a metallic low resistive layer, which can be used to source and drain regions. If this layer is utilized between source and drain, the noise figure of MISFETs, higher drain current of 1A/mm and fmax of 300 GHz is expected.[1] H.Matsuohara et al., IEEE Electron Device Lett 25, (2004) in press

B0.24 FIB Determination of the Lattice Longitudinal Shift Between Layers of the Strain-Compensated Si/SiGeC/Si HBT, Stanislaw E. Bezirganov$^{1}$, Hiskob (Ako) P. Bezirganov$^{1}$, Hayk E. Bezirganov$^{2}$ and Petros H. Bezirganov$^{2}$

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The investigation of dependence of the heterojunction bipolar transistor (HBT), performance characteristics, the lattice longitudinal space shifts between HBT epitaxial layers and the substrate is one of the important problems of non-destructive control in HBT fabrication process technology. Investigation methods based on the Grazing-Angle Incidence X-ray Backdiffraction (GIXB) technique are extremely sensitive for the measurements of the longitudinal space phase shifts stipulated by the misfit dislocations of the interface planes of the HBT epitaxial layers. The GIXB configuration first is considered in our papers [1, 2]. Lattice mismatch between SiGeC and Si constrains the domain of SiGe/Si heterojunction. Substitution incorporation of carbon into SiGe makes it possible to reduce and to control the compressive strain between the epitaxial layer and the substrate in Si/SiGeC/BSi HBTs (see, e.g. [3-5]). The buffer (base) SiGeC films in HBTs have less strain than a base SiGe film allowing the substrate and the function of carbon in the base suppress outdiffusion of boron, by which the parasitic barriers would be created. The performance features of HBTs with SiGeC base layer drastically do not change after the high temperature annealing. Consequence, the GIXB technique is extremely sensitive for the measurements of the longitudinal space phase shifts stipulated by the misfit dislocations of the interface planes of the HBT epitaxial layers.

**B0.25 1.55 μm Photoluminescence from β-FeSi$_2$, Micro precipitates-containing Films Prepared via Pulsed Laser Deposition, Aiko Narahashi, Tadatomo Sato, Yoshio Kawaguchi and Hironori Nono, Photonics Research Institute, National Institute of Advanced Industrial Science and Technology, Tsukuba, Ibaraki, Japan**

β-FeSi$_2$, the semiconducting low-temperature phase of iron disilicide, is promising as Si-based optoelectronic devices because of 1.55 μm luminescence well-matched to the transmission window of optical silica fibers as well as epitaxial relationship with Si crystalline structure. In a different perspective, β-FeSi$_2$ has received attention as an eco-friendly semiconductor due to the rich abundance of its constituents in natural resources and non-toxicity. These advantages have led to extensive study on the crystalline structure of the thin films by a variety of methods including ion beam synthesis, reactive deposition epitaxy, and magnetron-sputtering. However, these methods generally required high-temperature multi-processes such as films growth at ≥ 1000°C and post-annaling at ≥ 800°C from several hours up to a few days to achieve the precipitation of the beta phase. Such high-temperature procedures are not suitable for the device integration and degrade the semiconducting properties of β-FeSi$_2$ due to the appearance of α-FeSi$_2$ metallic phase. In this work, we successfully realized the room-temperature fabrication of β-FeSi$_2$ microprecipitates by the use of micro-meter-sized droplets generated by the laser ablation. We performed the KrF excimer laser ablation of an α-FeSi$_2$ metallic target and deposited hemispherical and droplet-like samples, which were kept at room temperature. Micro-Raman spectroscopy confirmed that thus obtained droplets precipitated preferentially as the β-FeSi$_2$ crystalline phase, whereas the rest of the deposited film was amorphous. Further improvement in the crystallinity of β-FeSi$_2$ was observed after pulsed laser annealing. It was also found that films containing a high density of β-FeSi$_2$ microprecipitates exhibited 1.55 μm photoluminescence at low temperatures up to 200 K after annealing at 800°C for 6 h in an argon atmosphere.

**B0.26 Study of Germanium Out-Diffusion in HfO$_2$ Gate Dielectric of MOS Device on Germanium Substrate, Qingzhao Zhang, Nan Wu and Chunxiang Zhu, Electrical and Computer Engineering, National University of Singapore, Singapore, Singapore.**

Germanium is an interesting channel material for MOSFET since it offers much higher mobility than silicon. However, the poor quality germanium oxide obstructs the fabrication of germanium MOS devices. With high-k material replacing the conventional thermal oxide in future VLSI technology, germanium is promising to be the channel material of high performance device. Several works on high-k HfO$_2$ deposition on germanium have been reported. The results show that during HfO$_2$ deposition or the following post deposition annealing (PDA), large amounts of germanium were found inside HfO$_2$ film. Thus, it is very interesting to study the mechanism of germanium diffusion into HfO$_2$ and its impact on the electrical properties of HfO$_2$ gate stack. In this work, the depends of Ge diffusion on the high-k deposition method, PDA temperature as well as PDA ambient were investigated. In addition, the electrical properties of HfO$_2$ MOS capacitors after Ge-incorporation were addressed. Thin HfO$_2$ film (5nm) was deposited on cleaved Ge single crystal wafer by MODF using Hf tri-butoxide precursor and O$_2$ at 400°C. A high concentration of germanium (8 atomic %) was found in the as-deposited HfO$_2$ by XPS at a 10° take-off angle. The presence of germanium was also confirmed by SIMS depth profiling. By using a surface nitridation with NH$_3$, the germanium concentration reduced about 60%. This showed that the Ge out-diffusion play a significant role in the germanium diffusion. However, Ge is still observed in HfO$_2$ film. It is suspected that the Ge out-diffusion may relate to the relative high temperature during MODF process. To exclude the effect of deposition temperature on Ge out-diffusion, the reactive sputtering method, by using a pure H$_2$ target in O$_2$ ambient at room.