3rd Call for Papers

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Compound Semiconductor Week 2023
(CSW 2023)

Abstract Submission Deadline (Extended): Feb. 28, 2023

May 29 – June 2, 2023
Ramada Plaza Jeju Hotel, Jeju, Korea

Call for Papers

The Compound Semiconductor Week (CSW) is the premier forum for science, technology, and applications of compound semiconductors. CSW 2023 is organized by the Semiconductor Physics Division of the Korean Physical Society (KPS) and focuses on the promotion of advanced research related to compound semiconductors.

CSW 2023 follows a series of successful meetings last held in Michigan, USA (2022), Stockholm, Sweden (2021, held virtually due to Covid-19), Nara, Japan (2019), Boston, USA (2018), Berlin, Germany (2017), Toyama, Japan (2016), Santa Barbara, USA (2015), Montpellier, France (2014), and Kobe, Japan (2013) and continues the tradition of bringing the compound semiconductor community together to discuss the latest advances in the field. As in previous years, CSW joins its predecessors, International Symposium on Compound Semiconductors (ISCS) and International Conference on Indium Phosphide and Related Materials (IPRM) in one event. CSW 2023 is the joint venue for the 49th ISCS and the 34th IPRM.

The conference will provide a variety of programs including distinguished presentations, networking events, and tours to benefit from informative and enriching discussions as well as to initiate cross-disciplinary collaborations for the advancement of research.

We are looking forward to receiving your abstracts with the most recent and exciting developments on compound semiconductors.

Important Dates

Abstract Submission Deadline: February 28, 2023
Acceptance Notification: March 29, 2023
Early Registraton Deadline: April 28, 2023

Conference Topics

CSW 2023 invites all professionals and academics interested in the most recent and exciting developments on compound semiconductors to submit oral and poster. We are looking forward to receiving your abstracts with the latest and high-quality research results on compound semiconductors.

01. Epitaxy, Fabrication, and Related Technologies
02. RF and THz Devices
03. High Power and High Frequency Electron Devices
04. Wide Bandgap Semiconductors
05. Photonic and Optoelectronic Devices and Related Technologies
06. Semiconductor Physics, Spintronics, Ferroelectronics, and Novel Device Concepts
07. Nanostructure and Nano Characterization
08. Oxide Semiconductors
09. Nanocarbon and Novel 2D Materials and Devices
10. Organic Semiconductors and Flexible Materials
11. Optoelectronics, Integrated Photonics, and III-V Electronic Devices on Si

Special Sessions: Emerging Materials and Innovative Technologies

SS1. Emerging Materials and Devices
SS2. Self-Driving Mobility and AI Applications
SS3. High-Resolution and Multi-Functional Display Technology
SS4. New-Conceptual Quantum Information and Communication
SS5. Highly Efficient Energy-Harvesting Technology
SS6. Advanced Convergence Technologies

KPS 한국물리학회
The Korean Physical Society

Semiconductor Physics Division, The Korean Physical Society (KPS)

Plenary Speakers

We are pleased to announce the strong and diverse plenary speaker line-up for CSW 2023. The following visionary speakers will share their experiences and insights on the latest trends and developments in the field of compound semiconductors.

Sven Höfling
(University of Würzburg, Germany)
"Single photon quantum technologies based on III-V semiconductor quantum dots"

Yung-Chung Kao
(IntelliEPI, USA)
"Hybrid-epitaxy, a new epi-model to support III-V Semiconductors"

Alexey Kavokin
(Westlake University, China)
"A new semiconductor platform for quantum technologies"

Jun-Youn Kim
(Samsung Display, Korea)
"Innovations for next generation display with III-V materials"

Masaya Notomi
(NTT Basic Research Laboratories / Tokyo Institute of Technology, Japan)
"Integrated nanophotonics for optoelectronic computations"

※ As of Jan. 25, 2023 (Being updated) | Alphabetical Order by Surname

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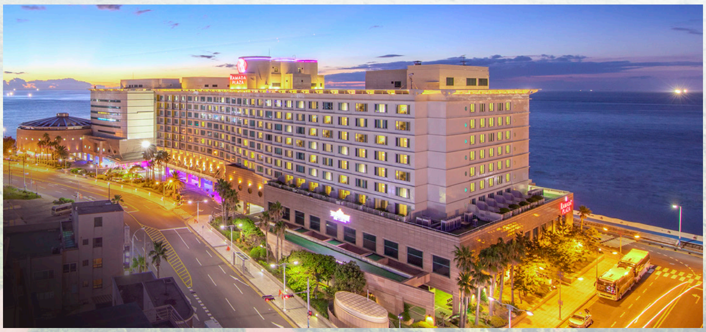
Visit Jeju, Korea in 2023!

Located in the southwest of the Korean Peninsula, Jeju Island is a popular tourist destination among domestic and international travelers for its beautiful and pristine natural scenery. Jeju Island is a unique place worldwide, holding the honors of the natural science area such as UNESCO World Biosphere Reserve [2002], UNESCO World Natural Heritage Site [2007], and UNESCO World Geoparks Network [2010]

Access to Jeju

Jeju International Airport, the 2nd largest airport in South Korea, is located in the north of Jeju Island. Jeju International Airport easily connects Korea with the major cities of China, Japan, and other Southeast Asian countries, via a total of 29 direct flight routes (13 domestic and 16 international). There are three ways to fly to Jeju Island: by direct international flight, by transferring at either Incheon International Airport or Gimpo Airport to a domestic flight to Jeju.

Venue: Ramada Plaza Hotel Jeju



The conference venue is a 5-star hotel with 400 guest rooms and suites and a convention room with a meeting capacity of 1200 people. This country's first costal hotel built right on the ocean is located just about 10~15 minutes away from Jeju International Airport and Jeju Port.

[WeA4-3]
18:15~18:30

Response Characteristics of InN-nanowire Flexible Photosensor Operating at the Wavelength Window of 1.3 μm

Jaehyeok Shin, Siyun Noh, Jinseong Lee, and Jin Soo Kim

Jeonbuk National University, Korea

[WeA4-4]
18:30~18:45

Responsivity Enhancement of $In_{0.53}Ga_{0.47}As$ Photo-FET Fabricated by Wafer Bonding on Si Substrate via Cavity Effect and EOT Scaling

Sung-Han Jeon[1,2], Dae-Hwan Ahn[1], Woo-Young Choi[2], and Jae-Hoon Han[1]

[1]Korea Institute of Science and Technology, Korea, [2]Yonsei University, Korea

[WeA4-5]
18:45~19:00

Towards High Performance Fully Vertical GaN-on-Silicon PIN Diodes

Youssef Hamdaoui[1], Idriss Abid[1], Sondre Michler[2], Katir Ziouche[1], and Farid Medjdoub[1]

[1]CNRS-IEMN, France, [2]Siltronic AG, Germany

[WeB4] Organic Semiconductors and Flexible Materials I

Room B (Ramada Ballroom 2, 2F) **May 31 (Wed.) / 17:30~19:00**

Session Chair(s)
Dong Chan Lim (Korea Inst. of Materials Science, Korea)
Ju Young Woo (Korea Inst. of Industrial Tech., Korea)

[WeB4-1]
17:30~18:00
Invited

Defect Engineering of Metal-halide Perovskites for Next-generation Optoelectronic Devices

Hobeom Kim

Gwangju Institute of Science and Technology, Korea

[WeB4-2]
18:00~18:30
Invited

Design and Application of Organic & Inorganic Materials for Flexible Optoelectronics

Soyeon Kim

Korea Institute of Materials Science, Korea

[WeB4-3]
18:30~18:45

White Color Generation Using Blue Top Emission OLED and Nanocrystalline Materials

Jaehyun Moon[1,2], Ju-Hun Lee[1,2], Jusun Park[3], Chul Woong Joo[1], Dae-Hyun Ahn[1], Joo Yeon Kim[1,2], Ju Young Woo[3], and Seung-Youl Kang[1]

[1]Electronics and Telecommunication Research Institute, Korea, [2]University of Science and Technology, Korea, [3]Korea Institute of Industrial Technology, Korea

[WeB4-4]
18:45~19:00

Annealing-Free Hole Transport Layers for Highly-Efficient and Stable Organic Solar Cells

Nurul Kusuma Wardani[1,2], Muhammad Jahandar[1], Yong Hyun Kim[2], Soyeon Kim[1], and Dong Chan Lim[1]

[1]Korea Institute of Materials and Science, Korea, [2]Pukyong National University, Korea

Responsivity Enhancement of $In_{0.53}Ga_{0.47}As$ Photo-FET Fabricated by Wafer Bonding on Si Substrate via Cavity Effect and EOT Scaling

Sung-Han Jeon[1,2], Dae-Hwan Ahn[1], Woo-Young Choi[2], Jae-Hoon Han[1*]
[1]Center for Opto-Electronic Materials and Devices, Korea Institute of Science and Technology (KIST),
[2]Department of Electrical and Electronic Engineering, Yonsei University, Korea
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Abstract*—To enhance the responsivity (R) of the photo-field-effect-transistor (photo-FET), the Equivalent Oxide Thickness (EOT) scaling, which changes gate dielectric such as HfO_2, ZrO_2, and Y_2O_3 used in the past CMOS technology node, has been introduced. In this study, we have compared the optoelectrical characteristics of Al_2O_3 with Al_2O_3/HfO_2. Although the photo-FET with the Al_2O_3/HfO_2 stack reduced the effective mobility (μ_{eff}) by 35%, the capacitance-equivalent-thickness (C_{ox}) was about twice increased. Also, in the Short-Wave-Infrared (SWIR) range, the reflectance was reduced by about 10% in the channel region. The photocurrent (I_{ph}) has increased by maximum of about 25% at the 50 µm channel length and of 40% at the 10 µm channel length. Based on these results, the calculated responsivity of photo-FETs having 10 µm and 50 µm channel lengths is improved by 12% and 37%, respectively. The photo-FETs with Al_2O_3/HfO_2 is a powerful device for the application requiring high responsivity in the SWIR range.

***Keywords*—$In_{0.53}Ga_{0.47}As$, Phototransistor, Photo-FET, MOSFET, Monolithic 3D Integration, Wafer bonding, high-k dielectric.**

I. INTRODUCTION

SWIR detectors are widely used in Si Photonics, medical devices, LiDAR sensors, and quantum computing. There are various photodetector structures in the SWIR range, such as PIN photodetector, avalanche photodiode (APD), and phototransistor. Because there are challenges in the detection of weak light by a conventional PIN photodetector without any internal gain, APD is widely used for weak light detection. However, APD also suffers from high operating voltage and a large excess noise [1]. On the other hand, phototransistors have been researched, which have variable internal gain with low operating voltage. Especially, there are many reports on 2D and organic photo-field-effect-transistors (photo-FET); however, these materials are difficult to realize efficient and stable detectors for a wide range of SWIR with CMOS-compatible platforms [2]. On the other hand, $In_{0.53}Ga_{0.47}As$ is already widely used for SWIR detection as PIN photodetectors with Si CMOS technology [3]. Also, $In_{0.53}Ga_{0.47}As$ photo-FET has recently been reported as an optical power monitor or photodetector with high responsivity and fast response time, integrated on Si platform using wafer bonding technology thanks to its high electron mobility, respectively [4, 5]. In our previous research, the responsivity of photo-FET with the metal gate was improved due to its cavity effect of a metal-oxide-semiconductor (MOS) structure with a metal reflector of W/Au (10/120nm) stack [5]. In this paper, we investigated its equivalent oxide thickness (EOT) scaling of the wafer-bonded photo-FET with a metal reflector, which is changing Al_2O_3 to Al_2O_3/HfO_2 stack.

II. EXPERIMENT

To fabricate wafer-boned $In_{0.53}Ga_{0.47}As$ photo-FETs with bottom metal reflector gate MOSFET structure, InGaAs/InP/n+InGaAs/InP/InGaAs on InP substrate grown by molecular beam epitaxy (MBE) was prepared. Then, Al_2O_3 or Al_2O_3/HfO_2 was deposited on the InGaAs surface using atomic layer deposition (ALD). The bonding metal (W/Au) was deposited on the insulator/InGaAs and SiO_2/Si substrate. The fabricated MOS structure on the InP wafer was transferred to the Si wafer using wafer bonding technology. The integrated III-V with the Si wafer introduced a top-down process from back etching to S/D Pad formation. The device structure and process flow are presented in Fig. 1(a) and (b).

III. RESULTS AND DISCUSSIONS

Figure 2 shows the electrical characteristics of photo-FET with Al_2O_3 and Al_2O_3/HfO_2 gate oxide. Figure 2(a) shows the I_d-V_g curve result with the V_g sweep range from -0.5 to 1.5V. Although the photo-FET with Al_2O_3/HfO_2 gate oxide has low effective mobility than that with Al_2O_3 gate oxide, C_{ox} of Al_2O_3/HfO_2 gate oxide shows an increase of more than 2 times over C_{ox} of Al_2O_3 gate oxide as shown in figure 2(b). Figure 2(c) shows the transconductance (g_m)-V_g curve in the voltage sweep range from -0.5 to 1.5 V. The photo-FET with Al_2O_3/HfO_2 stack shows more increased transconductance than that with Al_2O_3 gate oxide. Based on the previous results, we expect that the photo-FET with Al_2O_3/HfO_2 has a higher photocurrent according to the following equation:

$$I_{\mathrm{ph}} = \frac{\partial I_d}{\partial V_g}\Delta V_g = g_m \Delta V_{\mathrm{th}}, \qquad g_m = \frac{W}{L}\mu_{eff} C_{ox} V_{ds} \ [6]$$

where I_{ph}, g_m, W, L, u_{eff}, C_{ox}, and V_{ds} is photocurrent, transconductance, channel width, length, effective mobility and drain current, respectively. Figure 3 shows that the Al_2O_3/HfO_2 gate oxide has lower reflectance than Al_2O_3 in the IR range. This result indicates that the optical cavity effect is high in Al_2O_3/HfO_2 gate oxide and is expected to lead to increasing in I_{ph}. Figure 4 shows the optical characteristics of photo-FET. Figure 4(a) and (b) show photocurrent in the channel region of 10 μm and 50 μm, respectively. It indicates high photocurrent at photo-FET with Al_2O_3/HfO_2 gate oxide. In figure 4(c), Al_2O_3/HfO_2 gate oxide of photo-FET shows 12% and 37% increased responsivity than Al_2O_3 in 10 μm and 50 μm channel length, respectively at P_{in} =118.78 μW.

In conclusion, we have demonstrated wafer-bonded $In_{0.53}Ga_{0.47}As$ photo-FET with metal gate reflector and high-k dielectric (Al_2O_3/HfO_2) to achieve high optoelectrical characteristics such as I-V_G, C_{ox}-V_G, transconductance (g_m)-V_G, reflectance, and responsivity. This device achieved the enhancement of responsivity, which is 12% in 50 μm and 37% in 10 μm of length, due to the enhanced cavity effect and EOT scaling.

ACKNOLOGYMENT

This research was partially supported by the KIST institutional project (grant number 2E32242), and the National Research Foundation of Korea (NRF) grant (No. 2022R1C1C1007333 and 2022M3F3A2A01065057).

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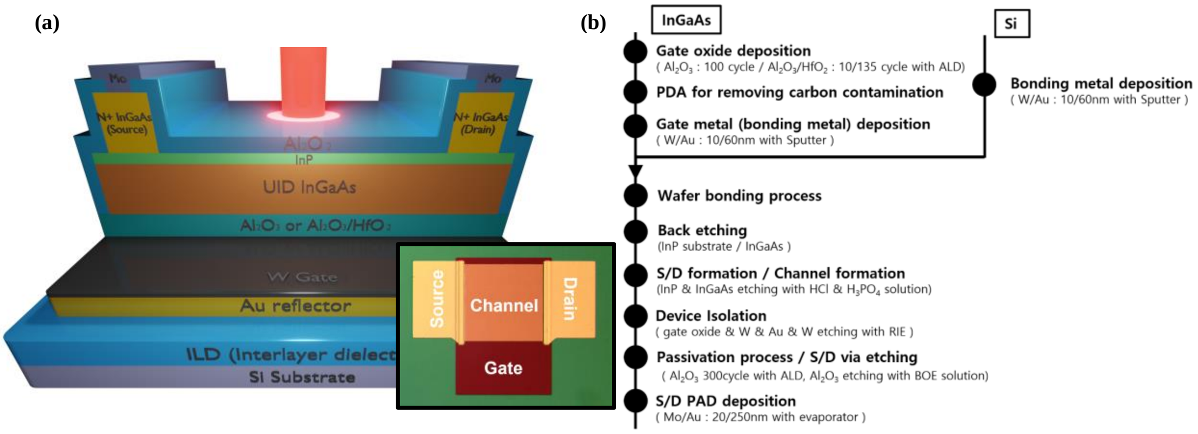

Fig. 1. (a) Schematics and optical image of wafer-bonded $In_{0.53}Ga_{0.47}As$ photo-FET. (b) Detail of process flow.

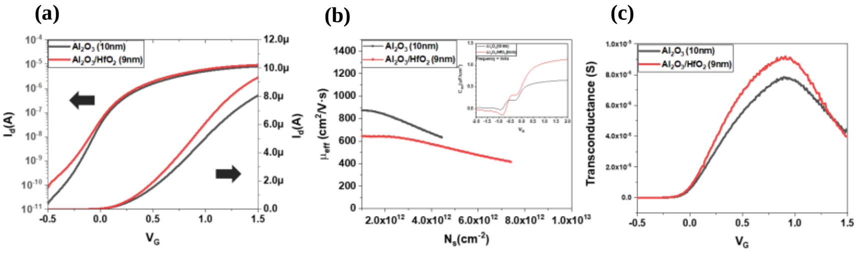

Fig. 2. Electrical characteristics of $In_{0.53}Ga_{0.47}As$ photo-FET (50 x 50 μm) depending on Al_2O_3 and Al_2O_3/HfO_2 gate oxide. (a) I_d-V_G curve with sweep range from -0.5 to 1V. (b) μ_{eff}-N_s and inset show the C_{ox}-V_G curve. (c) g_m-V_G curve from -0.5 to 1.5 V.

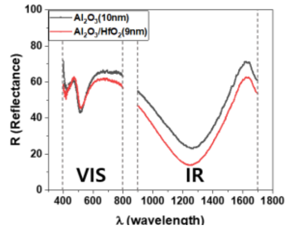

Fig. 3. Reflectivity of the channel region ($Al_2O_3/InP/In_{0.53}Ga_{0.47}As$/ Gate oxide/metal) from 400nm to 1700 nm wavelength depending on Al_2O_3 and Al_2O_3/HfO_2.

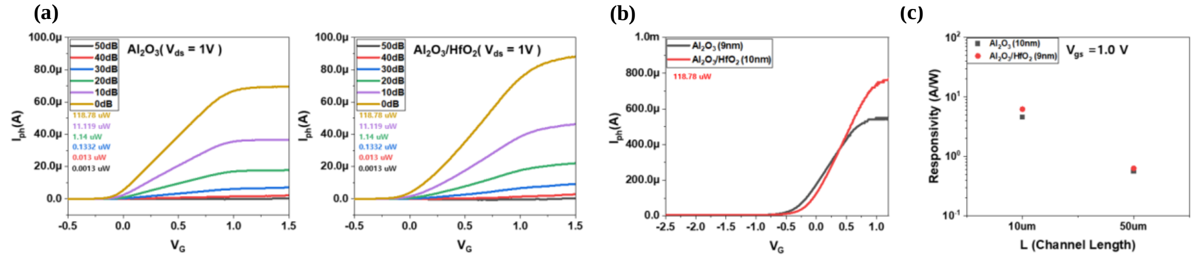

Fig. 4. Photocurrent of Al_2O_3 and Al_2O_3/HfO_2 gate oxide under various light power for (a) long channel device (L: 50 μm, W: 50 μm) and (b) short channel device (L: 10 μm, W: 50 μm). (c) Responsivities of different channel length at V_G = 1.0V.