

2013 JSAP-MRS Joint Symposia

Symposium T

Ternary and Multinary Cu-chalcogenide Photovoltaic Materials - CIS, CZTS and Other Compounds-

Symposium Organizers

Takahiro Wada, Ryukoku University

Shigeru Niki, AIST Research Center for Photovoltaic Technologies

Daniel Lincot, Institute of Research and Development of Photovoltaic Energy (IRDEP)

Yoon, Kyung-Hoon, Korea Institute of Energy Research

Oral Session

Date		9/19 Thu. 9:00-17:30			Room	M2
Time	Program #	Category	Title	Authors	Affiliations	
AM	9:00-9:30	19a-M2-1	Invited	CIGS PV Technology Today: Challenges, Opportunities and Potential	Rommel Noufi	NREL, USA
AM	9:30-9:45	19a-M2-2	Contributed	Multi-Layer Precursor Method for Cu(In,Ga)Se ₂ Solar Cells Fabricated on Flexible Substrate	Jakapan Chantana ¹ , Masashi Murata ¹ , Takashi Higuchi ¹ , Taichi Watanabe ² , Kazunori Kawamura ² and Takashi Minemoto ¹	¹ Ritsumeikan Univ. and ² Nitto Denko Corp., Japan
AM	9:45-10:00	19a-M2-3	Contributed	CIGS Thin Film Solar Cells with ZnS(O,H) Buffer Layers Deposited by a High-Rate Chemical Bath Deposition	Taizo Kobayashi, Toyokazu Kumazawa, Zacharie Jehl and Tokio Nakada	Tokyo Univ. of Science, Japan
AM	10:00-10:15	19a-M2-4	Contributed	GaInP/CuInGaSe Mechanical Stacking Multi-Junction Solar Cells using New Direct Bonding	Kikuo Makita, Hironori Komaki, Hidenori Mizuno, Hitoshi Sai, Takeyoshi Sugaya, Ryuji Oshima, Hajime Shibata, Koji Matsubara and Shigeru Niki	National Inst. of Advanced Industrial Science and Technology (AIST), Japan
AM	10:15-10:45	Break				
AM	10:45-11:15	19a-M2-5	Invited	CuGaSe ₂ Solar Cells with Over 10% Energy Conversion Efficiencies	Shogo Ishizuka, Akimasa Yamada, Yukiko Kamikawa, Hironori Komaki, Hajime Shibata and Shigeru Niki	National Inst. of Advanced Industrial Science and Technology, Japan
AM	11:15-11:30	19a-M2-6	Contributed	Narrow bandgap CuIn(SexTe1-x) ₂ solar cells using alternative buffer with 45mA.cm ⁻² short circuit current for tandem application	Zacharie Jehl Li Kao, Taizo Kobayashi and Tokio Nakada	Tokyo Univ. of Science, Japan
AM	11:30-11:45	19a-M2-7	Contributed	Enhanced Sodium Diffusion in CIGS Solar Cells with Mo/TCO/Mo Hybrid Back Contacts	Yukiko Shimizu Kamikawa, Hironori Komaki, Akimasa Yamada, Shogo Ishizuka, Koji Matsubara, Hajime Shibata and Shigeru Niki	National Inst. of Advanced Industrial Science and Technology, Japan
AM	11:45-12:00	19a-M2-8	Contributed	Effect of Au and MoOx layer between back electrode and CIGS rear surface on the cell performances of lift-off CIGS solar cells	Kenta Aoyagi, Akihiro Tamura, Hideyuki Takakura and Takashi Minemoto	Ritsumeikan Univ., Japan
	12:00-13:30	Lunch				
PM	13:30-14:00	19p-M2-1	Invited	CZTS thin film solar cells by sulfurization process	Hironori Katagiri ^{1,2} , Tsukasa Washio ^{1,2} and Kazuo Jimbo ¹	¹ Nagaoka National College of Technology and ² Japan Science and Technology Agency - CREST, Japan

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Date		9/19 Thu. 9:00-17:30			Room	M2
Time	Program #	Category	Title	Authors	Affiliations	
PM	14:00-14:15	19p-M2-2	Contributed	Fabrication of Cu ₂ ZnSnS ₄ Thin Films from Electrodeposited Metal Stacks	Shigeru Ikeda, Feng Jiang, Akio Kyoraiseki, Yoshito Kawasaki, Takashi Harada and Michio Matsumura	Osaka Univ., Japan
PM	14:15-14:30	19p-M2-3	Contributed	Rapid development of earth-abundant ternary copper sulfide absorbers	Lauryn Baranowski 2, Pawel Zawadski 1, Adam Welch 2, Colin Wolden 2, Eric Toberer 2, David Ginley 1, Stephan Lany 1 and Andriy Zakutayev 1	1 National Renewable Energy Lab. and 2 Colorado School of Mines, USA
PM	14:30-14:45	19p-M2-4	Contributed	Fabrication of Cu ₂ GeS ₃ -based Thin Film Solar Cells by Sulfurization of Cu/Ge Stacked Precursors	Hideaki Araki 1,2, Kotaro Chino 1, Kazuki Kimura 1, Naoya Aihara 1, Kazuo Jimbo 1 and Hironori Katagiri 1	1 Nagaoka National College of Technology and 2 Japan Science and Technology Agency, PRESTO, Japan
PM	14:45-15:00	19p-M2-5	Contributed	Fabrication of CuSbS ₂ Thin Films from Electrodeposited Metallic Stacks and Its Photovoltaic Applications	Wilman Septina, Shigeru Ikeda, Yuta Iga, Takashi Harada and Michio Matsumura	Osaka Univ., Japan
PM	15:00-15:30	Break				
PM	15:30-16:00	19p-M2-6	Invited	Defect Control of Kesterite Cu ₂ ZnSn(S,Se) ₄ for Thin-film Solar Cell Absorbers	Su-Huai Wei	National Renewable Energy Lab., USA
PM	16:00-16:30	19p-M2-7	Invited	Development of high efficiency Cu-chalcogenide thin-film solar modules	Hiroki Sugimoto	Showa Shell Sekiyu K.K., Japan
PM	16:30-17:30	19-M2-8		DISCUSSION: CZTS and new solar cells materials		

Date		9/20 Fri. 9:00-15:00			Room	M2
Time	Program #	Category	Title	Authors	Affiliations	
AM	9:00-9:30	20a-M2-1	Invited	An approach to enhance the CIGS solar cell efficiency up to 23%; numerical results	Akira Yamada 1,2, Yoshiaki Hirai 1 and Yasuyoshi Kurokawa 1	1 Tokyo Tech and 2 PVREC, Japan
AM	9:30-9:45	20a-M2-2	Contributed	Theoretical analysis of the influence of conduction band offset on the performance of CIGS solar cells using device simulation	Hajime Shibata, Masayuki Iioka, Akimasa Yamada and Shigeru Niki	National Inst. of Advanced Industrial Science and Technology, Japan
AM	9:45-10:15	20a-M2-3	Invited	First principles calculations on diffusion of Cu, In, Ga atoms in Cu(In,Ga)Se ₂	Tsuyoshi Maeda, Satoshi Nakamura and Takahiro Wada	Ryukoku Univ., Japan
AM	10:15-10:45	Break				
AM	10:45-11:15	20a-M2-4	Invited	Characterization of Electronic Structure of Oxy-sulfide Buffers and Band Alignment at Buffer/Absorber Interfaces in CIGS-based Solar Cells	Norio Terada 1,2, Hideki Morita 1, Kosuke Chochi 1, Sho Yoshimoto 1, Masahito Mitsunaga 1, Shogo Ishizuka 2, Hajime Shibata 2, Akimasa Yamada 2, Koji Matsubara 2 and Shigeru Niki 2	1 Kagoshima Univ. and 2 National Inst. of Advanced Industrial Science and Technology, Japan
AM	11:15-11:30	20a-M2-5	Contributed	Photoluminescence characterization of surface degradation mechanism in Cu(In,Ga)Se ₂ thin films grown on Mo/SLG substrate	Sho Shirakata, Hiroyuki Ohta, Kouichi Ishihira, Tatsuya Takagi, Akiko Atarashi and Shinji Yudate	Ehime Univ., Japan
AM	11:30-11:45	20a-M2-6	Contributed	Photovoltage Decay Processes in Cu(In,Ga)Se ₂ Solar Cells Investigated by Photo-assisted Kelvin Probe Force Microscopy	Hyeondeuk Yong 1, Yu Nakajima 1, Takashi Minemoto 2 and Takuji Takahashi 1	1 The Univ. of Tokyo and 2 Ritsumeikan Univ., Japan

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Date		9/20 Fri. 9:00-15:00			Room	M2
Time	Program #	Category	Title	Authors	Affiliations	
AM	11:45-12:00	20a-M2-7	Contributed	Investigation of deep defects in Cu(In,Ga)Se ₂ by two-wavelength excitation photocapacitance spectroscopy	Xiaobo Hu 1 , Amit Gupta 1 , <u>Takeaki Sakurai</u> 1 , Akimasa Yamada 2 , Shogo Ishizuka 2 , Shigeru Niki 2 and Katsuhiko Akimoto 1	1 Univ. of Tsukuba and 2 National Inst. of Advanced Industrial Science and Technology (AIST), Japan
	12:00-13:00	Lunch				
PM	13:00-13:30	20p-M2-1	Invited	Rapid thermal processing of nanoparticle precursors for CuInSe ₂ solar cell absorber layers	Alexander R. Uhl, Peter Fuchs, Carolin M. Fella, Yaroslav E. Romanyuk and <u>Ayodhya N. Tiwari</u>	Empa - Swiss Federal Labs. for Materials Science and Technology, Switzerland
PM	13:30-13:45	20p-M2-2	Contributed	Photochemical Deposition of Transparent p-type Alloy Cu _x Zn _y S and Its Application for Heterostructure Photovoltaic Cells	<u>Masaya Ichimura</u> , Man dula and Kai Yang	Nagoya Inst. of Technology, Japan
PM	13:45-14:00	20p-M2-3	Contributed	CuInS ₂ films by reactive-sputtering alternately Cu and In targets in Ar-diluted H ₂ S	<u>Nozomu Tsuboi</u> , Tomoya Ono and Tkahiro Nomoto	Niigata Univ., Japan
PM	14:00-14:15	20p-M2-4	Contributed	The Effect of Sputtering Power on The Properties of One-step Deposited Cu ₂ ZnSnSe ₄ Thin Films	<u>Yong Yan</u> 1 , Zhou Yu 1 and Yong Zhao 1,2	1 Southwest Jiaotong Univ., China and 2 Univ. of New South Wales, Australia
PM	14:15-14:30	20p-M2-5	Contributed	Effect of Electron Irradiation on Electroluminescence of CIGS Solar Cells	<u>Shirou Kawakita</u> 1 , Mitsuru Imaizumi 1 , Shuichi Okuda 2 , Shogo Ishizuka 3 , Hajime Shibata 3 , Hiroaki Kusawake 1 and Shigeru Niki 3	1 Japan Aerospace Exploration Agency, 2 Osaka Prefecture Univ. and 3 National Inst. of Advanced Industrial Science and Technology, Japan
PM	14:30-14:45	20p-M2-6	Contributed	High near infrared sensitivity of CIGS-based image sensor by 4-stage growth process	<u>Tetsuo Fujii</u> 1 , Noriyuki Masago 1 , Toshihisa Maeada 1 , Osamu Matsushima 1 , Hiroshi Sekiguchi 1 , Takushige Maekawa 1 , Yuji Ohta 1 , Koji Taniuchi 1 and Shigeru Niki 2	1 ROHM Co., Ltd. and 2 AIST, Japan
PM	14:45-15:00	20p-M2-7	Contributed	Electrical Properties of Ga ₂ O ₃ :Sn/CIGS Hetero-junction	<u>Kenji Kikuchi</u> 1,2 , Shigeyuki Imura 1 , Kazunori Miyakawa 1 , Misao Kubota 1 and Eiji Ohta 2	1 NHK Science and Technology Research Labs. and 2 Keio Univ., Japan

Poster Session

Date		9/18 Wed. 16:00-18:00			Room	P
Time	Program #	Category	Title	Authors	Affiliations	
PM	16:00-18:00	18p-PM5-1	Contributed	Precursor Dependence on CZTS Thin Films Prepared by Spray Pyrolysis	Koichiro Yoshitake, <u>Masami Aono</u> , Hiroaki Kishimura and Hisashi Miyazaki	National Defense Academy, Japan
PM	16:00-18:00	18p-PM5-2	Contributed	Microwave-assisted Synthesis of Cu ₂ ZnSnS ₄ Nanoparticles by Co-solvent Effect	<u>Wei-Chao Chen</u> 1,2,3 , Min-Hsueh Chiu 4 , Lian-Jiun Li 4 , Jih-Shang Hwang 4 , Kuei-Hsien Chen 1 and Li-Chyong Chen 3	1 Inst. of Atomic and Molecular Science, Academia Sinica, 2 National Tsing Hua Univ., 3 National Taiwan Univ. and 4 National Taiwan Ocean Univ., Taiwan
PM	16:00-18:00	18p-PM5-3	Contributed	Post-annealing effect on buffer-free CuInS ₂ solar cells with transparent conducting Zn _{1-x} Mg _x O:Al films	<u>Kasumi Okuda</u> , Yuji Fujita, Jakapan Chantana, Daisuke Hironiwa and Takashi Minemoto	Ritsumeikan Univ., Japan
PM	16:00-18:00	18p-PM5-4	Contributed	Spin Coating Synthesis of Uniform CZTSSe Thin Film using a Non-Toxic Solvent	<u>Venkatesh Tunugutnla</u> 1,2,3 , Wei-Chao Chen 1,2 , Kuei-Hsien Chen 1 and Li-Chyong Chen 3	1 IAMS, Academia Sinica, 2 National Tsing Hua Univ. and 3 National Taiwan Univ., Taiwan
PM	16:00-18:00	18p-PM5-5	Contributed	Annealing pressure dependence of Cu ₂ ZnSnSe ₄ composition and properties	<u>Zhou Yu</u> 1 , Chuanpeng Yan 1 , Yong Yan 1 , Lian Liu 1 and Yong Zhao 1,2	1 SW Jiaotong Univ., Chengdu, China and 2 Univ. of New South Wales, Sydney, Australia

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Date		9/18 Wed. 16:00-18:00			Room	P
Time	Program #	Category	Title	Authors	Affiliations	
PM	16:00-18:00	18p-PM5-6	Contributed	Crystallographic and optical properties of narrow band-gap Cu ₂ GeSe ₃	Masaru Morihama, Tsuyoshi Maeda and Takahiro Wada	Ryukoku Univ., Japan
PM	16:00-18:00	18p-PM5-7	Contributed	Fabrication of Cu ₂ SnS ₃ solar cells by screen printing and high-pressure sintering process	Takeshi Nomura, Tsuyoshi Maeda and Takahiro Wada	Ryukoku Univ., Japan
PM	16:00-18:00	18p-PM5-8	Contributed	Crystallographic and optical properties of CuInSe ₂ -ZnSe system	Koji Takei ¹ , Tsuyoshi Maeda ¹ , Takahiro Wada ¹ , Feng Gao ¹ and Seiji Yamazoe ²	1 Ryukoku Univ. and 2 The Univ. of Tokyo, Japan
PM	16:00-18:00	18p-PM5-9	Contributed	Optical Properties of Vacuum Evaporated AgGaTe ₂ Thin Films	Shunji Ozaki and Takayuki Ogura	Gunma Univ., Japan
PM	16:00-18:00	18p-PM5-10	Contributed	Probing Diffusion of In and Ga in CuInSe ₂ /CuGaSe ₂ Bilayer Thin Films Using XRD	Soijiphong Chatraphorn ^{1,2} , Boonyalak Namnuan ^{1,2} and Kajornyod Yoodee ^{1,2}	1 Chulalongkorn Univ. and 2 Thailand Center of Excellence in Physics, CHE, Thailand
PM	16:00-18:00	18p-PM5-11	Contributed	Sintering properties of CIGS absorption layer based on nanoparticle-ink	Jintign Jiu, Tohru Sugahara, Tukasa Takahashi, Manjeet Singh and Katsuaki Suganuma	Osaka Univ., Japan
PM	16:00-18:00	18p-PM5-12	Contributed	Solution phase synthesis of CuInGaSe ₂ nanoparticles for solar cell applications	Manjeet Singh, Jintign Jiu, Tohru Sugahara and Katsuaki Suganuma	Osaka Univ., Japan
PM	16:00-18:00	18p-PM5-13	Contributed	Preparation and characterization of copper gallium diselenide powders via the sol-gel route with a following selenization process	Zhi-Liang Liu, Shin-Hom Lin, Jeng-Hsin Ma and Chung-Hsin Lu	National Taiwan Univ., Taiwan
PM	16:00-18:00	18p-PM5-14	Contributed	Preparation and Characteristic of AgIn _{1-x} GaxSe ₂ Films via the Sol-gel Method	Guo-Ruei Chiu, Fu-Shan Chen, Jen-Cheng Sung and Chung-Hsin Lu	National Taiwan Univ., Taiwan
PM	16:00-18:00	18p-PM5-15	Contributed	Formation of CIGS nano-ink and application in solar cell	Tukasa Takahashi, Jintign Jiu, Tohru Sugahara, Manjeet Singh and Katsuaki Suganuma	Osaka Univ., Japan
PM	16:00-18:00	18p-PM5-16	Contributed	Cu ₂ ZnSnSe ₄ thin films prepared by selenization of precursor evaporated from Cu ₂ ZnSnSe ₄ and Na ₂ Se	Mitsuki Nakashima ¹ , Kohei Kawamoto ¹ , Toshiyuki Yamaguchi ¹ , Shigetoshi Niiyama ² and Toshito Imanishi ²	1 Wakayama National College of Technology and 2 Wakayama Industrial Technology Center, Japan
PM	16:00-18:00	18p-PM5-17	Contributed	Characterization of Cu(In,Ga)Se ₂ thin films and solar cells by photoacoustic spectroscopy	Akiko Atarashi ¹ , Masakazu Yagi ² , Shinji Yudate ¹ , Akira Miyata ¹ and Sho Shirakata ¹	1 Ehime Univ. and 2 Kagawa National College of Technology, Japan
PM	16:00-18:00	18p-PM5-18	Contributed	Two-step treatment of electroplated Cu/Sn bilayers: Impact of alloying before sulfurization	Hui-Ju Chen, Sheng-Wen Fu, Hsuan-Ta Wu, Shih-Hsiung Wu and Chuan-Feng Shih	National Cheng Kung Univ., Taiwan
PM	16:00-18:00	18p-PM5-19	Contributed	Effect of substrate temperature on the growth of Cu ₂ SnSe ₃ Thin Films	Kang Min Kim, Hitoshi Tampo, Hajime Shibata and Shigeru Niki	National Inst. of Advanced Industrial Science and Technology, Japan
PM	16:00-18:00	18p-PM5-20	Contributed	Synthesis of CuInS ₂ nanocrystals and their luminescence	Hokuto Kodate, Hiroyuki Suto and Itaru Kamiya	Toyota Technological Inst., Japan
PM	16:00-18:00	18p-PM5-21	Contributed	Nanostructure of CdS:O thin films by cathode sputtering	Masahiro Nakajima ¹ , Ryo Asaba ¹ , Akinori Suzuki ¹ , Nobuo Sato ¹ , Kazuki Wakita ¹ , Yon-Gu Shim ² , Nazim Mamedov ³ , Ayaz Bayramov ³ and Emil Huseynov ³	1 Chiba Inst. of Techonolgy, 2 Osaka Prefecture Univ., Japan and 3 Inst. of Physics, Azerbaijan
PM	16:00-18:00	18p-PM5-22	Contributed	CuInS ₂ epitaxial films on GaAs substrates by pulse laser deposition	Ryo Yoshida ¹ , Yusuke Horikawa ¹ , Yon-Gu Shim ² and Kazuki Wakita ¹	1 Chiba Inst. of Technology and 2 Osaka Prefecture Univ., Japan
PM	16:00-18:00	18p-PM5-23	Contributed	Investigation of Sulfurization Process of Cu ₂ SnS ₃ Thin Films for Next Generation Solar Cells	Soichi Sato, Yoshiki Kayama and Mutsumi Sugiyama	Tokyo Univ. of Science, Japan

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Date	9/18 Wed. 16:00-18:00	Room	P
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Time	Program #	Category	Title	Authors	Affiliations	
PM	16:00-18:00	18p-PM5-24	Contributed	Sulfurization Temperature Dependence of Photovoltaic Properties in Cu ₂ SnS ₃ -based Thin Film Solar Cells	<u>Naoya Aihara</u> 1 , Ayaka Kanai 1 , Kazuki Kimura 1 , Manami Yamada 1 , Kotoba Toyonaga 1 , Hideaki Araki 1,2 , Akiko Takeuchi 1 and Hironori Katagiri 1	1 Nagaoka National College of Technology and 2 Japan Science and Technology Agency, PRESTO, Japan
PM	16:00-18:00	18p-PM5-25	Contributed	Preparation of CuInS ₂ by Crank Ball Mill	<u>Yoji Akaki</u> 1 , Shogo Higashi 1 , Yuki Tokudome 1 , Tomoichiro Okamoto 2 and Masasuke Takata 2	1 Miyakonojo National College of Technology and 2 Nagaoka Univ. of Technology, Japan