### OWPT2021 Agenda At-A-Glance

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<th>Apr. 19 (Mon.)</th>
<th>Apr. 20 (Tue.)</th>
<th>Apr. 21 (Wed.)</th>
<th>Apr. 22 (Thu.)</th>
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<tr>
<td><strong>9:00</strong></td>
<td>S. Fafard</td>
<td>C. Davlantes</td>
<td>T. Nugent</td>
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<tr>
<td>9:15</td>
<td><em>Power and Spectral Range Options for</em></td>
<td><em>New microwave power beaming</em></td>
<td><em>Improving Performance Metrics for</em></td>
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<tr>
<td>9:30</td>
<td>M. Miyoshi</td>
<td>P. Jaffe</td>
<td>P. Leisher</td>
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<td>9:45</td>
<td><em>GaN-based solar cells and their</em></td>
<td><em>Power Beaming and Space</em></td>
<td><em>Longitudinal current crowding in high</em></td>
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<td>10:00</td>
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<td>H. Fujimoto</td>
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<td>10:15</td>
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<td><em>In-wheel motor EV and dynamic</em></td>
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<td>10:30</td>
<td>Coffee Break</td>
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<td>14:00</td>
<td>Opening Remarks</td>
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<td>14:15</td>
<td>Y. Shoji</td>
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<td>14:30</td>
<td><em>Novel low-cost fabrication method (H-VPE)</em></td>
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<td>15:30</td>
<td>A. Kudryashov</td>
<td>V. Khorenko</td>
<td>H. Helmers</td>
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<td>15:45</td>
<td><em>Free-space laser communication</em></td>
<td><em>Infrared Laser Power Converters</em></td>
<td><em>III-V based Photonic Power</em></td>
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<td>16:30</td>
<td>H. Haas</td>
<td>S. Sweeney</td>
<td>A. Tonini</td>
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<td>16:45</td>
<td><em>The Road Towards Zero-Energy</em></td>
<td><em>Optical wireless power at eye-safe</em></td>
<td><em>High power single mode expanded</em></td>
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- **Plenary Talk**
- **Special Talk**
- **Invited Talk**
- **Regular Paper**
- **Live Poster Session**

**Notes:**

- Coffee Break
- Lunch Break
- Live Poster Session

**WOPT-2-02  16:00**

Free Space Optical Link for Simultaneous Power and 1 Gb/s Data Transmission

John Fakidis1, Henning Helmers2, Harald Haas1
1University of Strathclyde, 2Light Fidelity Research and Development Centre, 1Fraunhofer Institute for Solar Energy Systems ISE

We study the trade-off between power and data transfer for a two-meter wireless gallium-arsenide laser and photovoltaic link. The use of orthogonal frequency-division multiplexing with adaptive bit and power loading results in a peak data rate of 1041 Mbit/s. The photovoltaic receiver is shown to offer simultaneous power harvesting with 41.6% efficiency under the irradiance of 0.3 W/cm² and a data rate of 784 Mbit/s.

**WOPT-2-03  16:15**

Charging Requirements and Verification Experiments for the Introduction of Optical Wireless Power Transmission Systems for Smart Devices

Naoki Uchiyama, Hirohito Yamada, Tohoku University

As an example, charging requirements of a portable media player were shown, and a verification experiment was carried out. We also investigated the wavelength of the light source. It was found that it can be charged by storing electricity in an electric double layer capacitor and the power from a solar cell was higher when using near-infrared light than when using visible light.

**WOPT-2-04  16:30**

Optimization of Design and Operation Power of the Portable LED-based OWPT System for Compact IoT

Yukihito Zhou, Mingrui Zhao, Tomoyuki Miyamoto
1FIRST, Tokyo Institute of Technology

Optical wireless power transmission technology, which has advantages like long distance transmission and good directionality, is still at the initial stage. Considering the relatively loose regulations and other merits, researching on LED-based OWPT system is imperative. In this research, LED-based OWPT system has been optimized in two directions, the dimension and output power.

**WOPT-2-05  16:45**

The Road Towards Zero-Energy Gigabit Wireless Transceivers

Harald Haas
University of Strathclyde

We demonstrate that it is possible to simultaneously transfer power and receive high-speed digital data using the same photovoltaic (PV) cell. Different PV technologies are reviewed in this context and potential use cases are highlighted. The proposed dual use of PV cells has the potential to play a major role towards net-zero wireless networks, while enabling the continuous growth in the number of connected devices, data rate performance and coverage to mitigate the digital divide.

**WOPT-3  9:00-10:30**

**WOPT Session 3**

Chairs: S. Uchida
UCB, Chiba Inst. Tech. 1, T. Takeuchi, Meijo Univ.

**WOPT-3-01  9:00**

Invited

Power and Spectral Range Options for Optical Power Converter Products

Simon Fatadar
Broadcom

High-performance Optical Power Converters (OPCs) enable more applications at new wavelengths and higher output powers. Broadcom’s patented VHEGA multi-junction OPCs exhibit high-efficiency conversion at manageable external loads. This paper reviews how we extended the power outputs from 600mW to 2W and higher, and how the spectral range options extend from the 800-830nm range to other key laser diode wavelengths such as 980nm and 1500nm.

**WOPT-3-02  9:30**

Invited

GaAs-based Solar Cells and their Application to Optical Wireless Power Transmission System

Makoto Miyoshi
Nagoya Institute of Technology

To consider the application of GaAs-based solar cells to the optical wireless power transmission system, their photovoltaic performance was evaluated under monochromatic light irradiation. The results predicted that their power conversion efficiency can reach to 60% or higher with a high-power light irradiation, an anti-reflection coating and the suppression of carbiner reradiation combinations.

**WOPT-3-03  10:00**

Fabrication and Characterization of GaP Based Photovoltaic Devices for Short Wavelength Range Optical Wireless Power Transmission

Masakazu Arai, Akira Kushiyama, Koji Maeda, Koji Miyazaki
University of Miyazaki

We fabricated two types of GaP photovoltaic devices with different electrode shape and passivation and evaluated the characteristics. We successfully confirmed high open circuit voltage as high as 1.74V under blue laser irradiation.

**WOPT-3-04  10:15**

Non-Uniform Illumination Impacts on 0-Band InGaAs and Metamorphic GaInAs Photonic Power Converters

Meghan Nicholas Breatt1, Henning Helmers2, Christopher E. Valdivia2, David Lackner3, Oliver Hilt1, Karin Nitzel3
1SUNLAB. Centre for Research in Photonics, University of Ottawa, 2Fraunhofer Institute for Solar Energy Systems ISE

Single-junction photonic power converters designed for operation in the telecommunications O-band are measured under 1319-nm laser illumination with a range of beam diameters. Device performance is found to improve as the illumination becomes more uniform. Two absorber materials are evaluated in this study, InGaAs lattice-matched to InP and metamorphic GaInAs on lattice-mismatched GaAs with maximum efficiencies of nearly 53% and 49% respectively.
**OWPT-5-01 9:00**

Augmenting the Performance of Microwave Wireless Power Networks by Incorporating Metasurface-Based Mesh Nodes

By: Cristina Daviades
Reach Labs

Conventional microwave wireless power networks struggle to serve many devices at long distances simultaneously while maintaining a high power transfer efficiency to every node in the network. By adopting a mesh architecture enabled by adaptive metasurfaces, this work overcomes the limitations of prior WPT networks and provides a compelling avenue for further research. Theoretical calculations and simulations are presented.

**OWPT-5-02 9:30 Invited**

Power Beaming and Space Applications

By: Paul Jaffe
Naval Research Laboratory

Power beaming technology has made significant recent strides in consumer, industrial, and defense sectors. Though proposed for many decades for various space applications, few significant demonstrations of power beaming technology have taken place in space. The scale of envisioned space power beaming applications ranges from those over short distances within spacecraft, medium distances between spacecraft or platforms on celestial bodies, long distances between space and celestial bodies, and very long distances for beamed energy propulsion. Each is explored herein.

**OWPT-5-03 10:00 Special**

In-wheel Motor EV and Dynamic Charging using Wireless Power Transfer

By: Hiroshi Fujimoto, Osamu Shimizu
The University of Tokyo

In our laboratory, a second-generation wireless in-wheel motor (W-IWM) having the capability of dynamic wireless power transfer (D-WPT) on its wheel side has been developed. The D-WPT technology can drastically extend the driving range of electric vehicles. The W-IWM is also developed to reduce the size and to increase the power. This talk introduces the development of the W-IWM and W-IWM with the experimental results.

**OWPT-5-04 11:30 Invited**

High Power Single Mode Expanded Beam Fiber Optic Connectors for Power over Fiber Applications

By: Andrea Torini, Aoife Geris, Victor Coggi

Technologies of high-power single-mode fiber connectors for Power Over Fiber applications are explored.

**OWPT-6-02 16:00**

Current Mismatch and Luminiscence Coupling in Three-junction Photonic Power Converters with and without Back Reflector

By: Esther Lopez, Oliver Höhn, Meke Schauter, David Lackner, Michael Schachtner, S. Kasimi Reichmuth, Henning Helmers

Fraunhofer Institute for Solar Energy Systems ISE, Freiburg, Germany; Istituto di Energia Solare – Universidad Politecnica de Madrid, Madrid, Spain

In this work the coupling process efficiency in three-junction photonic power converters based on GaAs/AlGaAs heterojunction subcells is experimentally quantified. A coupling process efficiency of 32% ± 9% from top and middle subcells to the limiting bottom subcell is found. Furthermore, it is evidenced how a back reflector affects luminescence coupling of these devices by re-directing photons that are emitted by the bottom subcell towards the upper subcells.

**OWPT-6-03 16:15**

Power-over-Fiber Smart Sensor Fully-Connected in a Hybrid Fiber/Power Distribution Cable

By: Fabio Rauldo Basari, Joao Batista Rosoleim, Claudio Florinda, Bruno Nogueira Arias, Rodrigo Pereira, Javier Francisco Aparaez, Carlos Alejandro Mireles de Nascimento

In this work the coupling process efficiency of power-over-fiber (POF) current and voltage sensor using optical, optoelectronic, and electrical technology the smart sensor was tested with powering, metering, and data transmission functions performed simultaneously in a 1.38-kV hybrid aerial fiber/power distribution cable of experimental field installation.

**OWPT-6-04 16:30 Invited**

Improving Performance Metrics for Power Beaming

By: Tom Nugent

Power,Light Technologies

This paper gives an overview on research and development of the W-IWM2 and W-IWM3 developed to reduce the size and to increase drastically extend the driving range of high power electric vehicles. This talk introduces the development of these devices by re-directing photons that are emitted by the bottom subcell towards the upper subcells.

**OWPT-7-01 9:00 Invited**

Longitudinal Current Crowding in High Power Diode Lasers

By: Jenna Campbell, Michelle Labrecque, Elliot Burke, Kevin McQuire, Daniel Renner, Paul Leiser

Freedom Photonics LLC

This work presents the results of the field tests of an innovative utilization concept for power-over-fiber (POF) current and voltage sensor using optical, optoelectronic, and electrical technology. The smart sensor was tested with powering, metering, and data transmission functions performed simultaneously in a 1.38-kV hybrid aerial fiber/power distribution cable of experimental field installation.

**OWPT-7-02 9:30 Invited**

Improvement of Power Conversion Efficiency of VCSELs by 3D Resistance and Light Absorption Control using Proton Implication for Use in OWPT

By: Tomoyuki Miyamoto, Huyto Sakamoto

Tokyo Institute of Technology

Improving the power conversion efficiency (PCE) of VCSELs by 3D control of the carrier concentration, which is the main mechanism of electrical resistance and light absorption, was investigated using proton implantation technique just above the active region. The fabricated VCSELs showed an improvement in PCE of about 1.1 times without a significant deterioration of other characteristics. This technique will be useful to improve the efficiency of OWPT.

**OWPT-7-03 10:00**

Improving Performance of Power Beaming

By: W. Kubo

Yamashita Denso

Improving Performance of Power Beaming

By: Tom Nugent

Power,Light Technologies

Beam Control Stabilization of OWPT System with Recognition Module and its Application to Multiple Light Source OWPT System

By: Jingfang Li, Koji Ueda, Tomoyuki Miyamoto
Tokyo Institute of Technology

Multi-light source systems are attractive to OWPT because of high efficient transmission capabilities. In addition, high functionalities such as selection of efficient transmission paths can be prepared by multiple light sources. In this research, we constructed an OWPT system with improved stability in both recognition and beam control and demonstrated a system with real time switching.

**OWPT-7-04 10:15 Invited**

Improving Performance Measurements for Optical Devices Based on Calorimetric Method

By: Tomomi Saito, Takahiro Chiba, Momo Karita, Shigeki Touyuya
Tokai University of Technology

Conversion efficiencies of optical devices, both sources and receivers have been measured based on a calorimetric method. To automate the operation, a negative feedback control circuit to maintain constant temperature by adjusting the electrical power to the heater has been developed and proved to work successfully.

**OWPT-7-05 11:00 Invited**

Conversion Efficiency Measurements for Optical Devices Based on Calorimetric Method

By: Tomomi Saito, Takahiro Chiba, Momo Karita, Shigeki Touyuya
Tokai University of Technology

Conversion efficiencies of optical devices, both sources and receivers have been measured based on a calorimetric method. To automate the operation, a negative feedback control circuit to maintain constant temperature by adjusting the electrical power to the heater has been developed and proved to work successfully.

**OWPT-7-06 11:30**


By: Shicheng Lu, Alexander William Setiawan Putra, Kosuie Imamura, Takuo Manayama
Kanazawa University

In OWPT system using camera for target recognition, prediction of the next position of target which is captured by the camera is important to ensure that laser can be steered to follow moving target. Machine learning is implemented to predict next position of target on next captured frame. Using machine learning method, 75% error for position has been achieved in simulation compared with linear prediction method.

**OWPT-8-01 11:00 Invited**

Beam Control Stabilization of OWPT System with Recognition Module and its Application to Multiple Light Source OWPT System

By: Jingfang Li, Koji Ueda, Tomoyuki Miyamoto
Tokyo Institute of Technology

Multi-light source systems are attractive to OWPT because of high efficient transmission capabilities. In addition, high functionalities such as selection of efficient transmission paths can be prepared by multiple light sources. In this research, we constructed an OWPT system with improved stability in both recognition and beam control and demonstrated a system with real time switching.

**OWPT-8-02 11:15**

Moving Target Position Prediction for Optical Wireless Power Transmission System using Machine Learning

By: Shicheng Lu, Alexander William Setiawan Putra, Kosuie Imamura, Takuo Manayama
Kanazawa University

In OWPT system using camera for target recognition, prediction of the next position of target which is captured by the camera is important to ensure that laser can be steered to follow moving target. Machine learning is implemented to predict next position of target on next captured frame. Using machine learning method, 75% error for position has been achieved in simulation compared with linear prediction method.

**OWPT-8-03 11:30**

Closing Remarks

By: W. Kubo

Yamashita Denso

Closing Remarks

By: W. Kubo

Yamashita Denso

Closing Remarks

By: W. Kubo

Yamashita Denso
**OWPT**

**Poster (Live Poster: Tue. 20 and Wed. 21 April, 11:00-12:00)**

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<th>Numerical Analysis of Multi-particle Mie Scattering Characteristics for Improvement of Solar Cell Appearance in OWPT System</th>
<th>Yu Lu, Tomoyuki Migmatoto</th>
<th>Tokyo Institute of Technology</th>
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<td>OWPT-P-02</td>
<td>Simultaneous Fiber Transmission of Control and Mobile Communication Signals in Power-over-Fiber Drones for Airborne Base Stations</td>
<td>Taku Kozuikawa, Natsuki Shirai, Motoharu Matsuura</td>
<td>The University of Electro-Communications</td>
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<td>OWPT-P-03</td>
<td>Evaluation of Wavelength Dependence in Feed light Transmission Loss of Double-Clad Fiber for Power-over-Fiber Applications</td>
<td>Suguru Fujita, Tadanobu Higuchi, Hikaru Mamiya, Motoharu Matsuura</td>
<td>The University of Electro-Communications</td>
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<td>OWPT-P-04</td>
<td>For Fabrication of Waveguides based on Polydimethylsiloxane for Multistriped Orthogonal Photon-Photocarrier Propagation Solar Cell (MOP3SC) System</td>
<td>Xingbai Hong, Jiaojie Yu, Nibuo Sawamura, Akira Ishibashi</td>
<td>Haskins University</td>
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<td>OWPT-P-05</td>
<td>Optical Wireless Communication and Power Transmission with Long-distance Propagation in Atmospheric Turbulence</td>
<td>Konami Yada, Yu Takagi, Kayo Ogawa</td>
<td>Japan Women’s University</td>
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<td>OWPT-P-06</td>
<td>Effect of Uniform Laser Irradiation on the Efficiency of GaAs Solar Cells for Optical Wireless Power Transmission</td>
<td>Kazuki Kurooka, Shinya Honda, Yuki Komuro, Ryusuke Wariyama, Shiro Uchida</td>
<td>Chiba Institute of Technology</td>
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<td>OWPT-P-07</td>
<td>Investigation of Laser Wireless Power Transmission using Infrared InGaAs/InGaAsP 2-junction Solar Cell</td>
<td>Naomi Matsuoka, Tomoyuki Kato, Yuki Komuro, Li Yuefei, Shukong Lu, Shiro Uchida</td>
<td>Chiba Institute of Technology, Suzhou Institute of Nano-Tech and Nano-Science</td>
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<td>OWPT-P-08</td>
<td>Energy Conversion Efficiency under Different Input Electrical Power Conditions in Visible LED based OWPT System</td>
<td>Haruka Yakoyama, Natki Yaseuki, Tomohiro Yamaguchi, Tomoyuki Miyamoto, Takeyoshi Onuma, Tohru Honda</td>
<td>Kogakuin University, Tokyo Institute of Technology</td>
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<td>OWPT-P-09</td>
<td>Laser Wireless Power Transmission in Seawater Environment</td>
<td>Shunji Hayashi, Yuma Aoki, Yuki Komuro, Tomoya Sudo, Tomoyuki Kato, WONG Yu Leung, Shiro Uchida</td>
<td>Chiba Institute of Technology</td>
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<td>OWPT-P-10</td>
<td>Visible Laser Wireless Power Transmission Using a Beam Expander</td>
<td>Yiu Leung WONG, Taiga Shibuya, Ryoizumi Wariyama, Yuki Komuro, Shunji Hayashi, Tomota Sudo, Tomoyuki Kato, Shiro Uchida</td>
<td>Chiba Institute of Technology</td>
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<tr>
<td>OWPT-P-11</td>
<td>Experimental Investigation of Electrode Design for Photovoltaic device for Laser Receiving Photovoltaic Device</td>
<td>Akira Kushihara, Masakazu Arai</td>
<td>University of Miyazaki</td>
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For high conversion efficiency of laser light receiving device, we experimentally investigated the electrode size and pitch dependence of photovoltaic characteristics of GaAs based device. Clear tendency against shadowing loss was observed under laser irradiation.