APPLIED PHOTONICS AWARD

Fraunhofer IOF

FRAUNHOFER INSTITUTE FOR APPLIED OPTICS AND PRECISION ENGINEERING IOF

PRESS RELEASE

"Applied Photonics Award 2024": These are the winners

Fraunhofer IOF Young Researcher Award for Innovative Theses Presented

Jena

From improved diagnostics for tissue samples and new manufacturing processes for the electronics industry to the high-precision synchronization of clocks using tiny quanta - the Applied Photonics Award 2024 once again honored young researchers for their pioneering theses in the field of applied photonics. The prize was awarded on September 26 as part of the Photonics Days Jena.

Under the motto *Heading towards the future at the speed of light,* the Applied Photonics Award honors young researchers and their outstanding theses, exploring innovative solutions in applied photonics and providing key impulses for our technological future. The young talent award, organized by the Fraunhofer Institute for Applied Optics and Precision Engineering IOF, was presented on September 26 as part of the Photonics Days Jena. Prof. Dr. Andreas Tünnermann, Director of Fraunhofer IOF, presented the awards together with Dr. Marc Krug of Jenoptik AG.

A jury of experts consisting of representatives from science and industry had previously selected the award-winning theses. In 2024, three theses were awarded in the categories of Bachelor's, Master's, and Doctoral dissertations. Additionally, the jury introduced three special awards this year for scientific excellence, sustainability, and biophotonics, further highlighting the breadth and excellence of the submitted projects.

The winners of the "Applied Photonics Award" 2024 are:

Best Bachelor Thesis (€ 1.000)
Leon Fuchs (Aalen University): "*Concept of a Multi-Spectral Light Source as a Halogen Lamp Replacement*"

Precise light sources play a key role in medical diagnostics and modern analysis techniques. Especially in pathology, subtle color differences are crucial for detecting pathological changes in tissue samples. Until now, traditional halogen lamps have been used for this purpose, which, although capable of differentiating colors, are limited by their heat output and short lifespan.

Leon Fuchs' thesis focuses on developing a multi-spectral light source to energy-efficiently replace halogen lamps in medical applications. By combining LEDs of different spectral ranges, he creates a continuous, true-color light. This innovative light source is

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not only more flexible but could also significantly improve the precision of medical diagnostics and treatments in the future.

Best Master Thesis (€ 2,000)
Paula Heik (Friedrich-Alexander-University Erlangen-Nuremberg): "Development and Characterization of AlN VAT Photopolymerization"

From smartphones to laptops and modern vehicles, electronic devices are an integral part of our daily lives. However, the production of their components is becoming increasingly complex, requiring new, more efficient manufacturing technologies. Materials like aluminum nitride (AlN) are playing an increasingly important role in the electronics industry, meeting thermal and electrical requirements.

In her master's thesis, Paula Heik explores the use of VAT photopolymerization to manufacture ceramic structures based on AlN. This method allows the curing of liquid polymeric resins using targeted light exposure while incorporating ceramic particles. Compared to conventional methods like casting or pressing, this approach offers greater design flexibility and enables the precise production of complex structures. This could unlock new applications in the semiconductor and electronics industries and lead to more cost-effective production processes.

Best Dissertation (€ 3,000):
Dr. Christopher Spiess (Friedrich Schiller University Jena): "Clock Synchronization with Single Photons"

In our connected world, secure communication and the protection of critical infrastructure are two key challenges for the future. Quantum communication networks, based on the transmission of single light particles—photons—could offer a solution for particularly secure data transmission. Photons are extremely sensitive to manipulation, enabling detection of eavesdropping attempts by unauthorized third parties.

In his dissertation, Christopher Spiess developed a protocol for high-precision clock synchronization in such quantum communication networks, based on single photons without requiring additional synchronization patterns or highly stable atomic clocks. This method offers greater accuracy and stability than existing technologies. In addition to quantum communication, the innovative synchronization protocol has the potential to be used in critical infrastructures, such as energy or water supply networks. Furthermore, mobile devices like laptops or smartphones could easily be integrated into future secure (quantum) communication networks using this method. The procedure also opens up new possibilities in quantum computing and space exploration.

Jury Prize for Scientific Excellence (€ 1,000)
Nils Bernhardt (Technical University of Berlin): "Optical Bound States in the Continuum: Boosting the Effective Nonlinear Susceptibility of WS2"

In modern optoelectronics, the precise manipulation of light is becoming increasingly important. Whether in sensors or telecommunications, the ability to amplify and precisely control light can significantly improve the performance of devices.

Nils Bernhardt's work investigates how light can be concentrated and enhanced on nanostructured surfaces. He demonstrates that by integrating an atomically thin material layer with special properties, concentrated light can be used to enhance optical phenomena. This technology could be utilized in photonic and optoelectronic devices, such as sensitive sensors or the miniaturization of circuits. In the future, this could also improve the speed and efficiency of smartphones and telecommunications systems.

Jury Prize for Applications in Sustainability (€ 1,000)
Karina Trindade Ribeiro (Karlsruhe Institute of Technology): "Hybrid PV-Thermal and Radiative Cooling Technology for Tri-Generation of Electricity, Heating, and Cooling"

Addressing climate change requires new, sustainable technologies that not only generate energy efficiently, using all resources available. In urban areas, compact, multifunctional solutions for resource-efficient energy generation are particularly necessary to meet the demands of limited space.

In her master's thesis, Karina Trindade Ribeiro presents an innovative hybrid device that offers an efficient, holistic approach to energy generation in urban residential areas. The device enables the simultaneous generation of electricity, heating, and cooling in a single space. The demonstrates that such a device is physically possible and highlights the potential for application in various residential and commercial buildings. In the long term, the PVT-RC hybrid device could significantly expand the possibilities for resource-efficient energy generation.

Jury Prize for Applications in Biophotonics (€ 1,000)
Dr. Jakob Lingg (Technical University of Munich): "Shortwave-Infrared Line-Scanning Confocal Microscope for Deep Tissue Imaging"

The precise imaging of structures and processes in biological tissue is crucial for diagnostics and medical research. Particularly during surgery, imaging techniques with high sensitivity, as well as spatial and temporal resolution, are of great importance, as they can enable precise interventions.

In his dissertation, Jakob Lingg developed biomedical imaging techniques in the short-wave infrared wavelength range (SWIR). On the one hand, he developed a microscope that enables high-resolution 3D imaging of biological tissue. The line-confocal

microscope he developed, in combination with biocompatible dyes, offers both high spatial and temporal resolution while providing deep tissue penetration. This is particularly valuable for real-time observation of biological processes in deeper tissue layers and thus has relevant applications during surgical procedures.
Additionally, Lingg worked on macroscopic imaging techniques that allow the parallel imaging of multiple biological structures and processes in an entire organism in real time. This makes it possible to observe freely moving objects without the need for anesthesia. This is of great importance for biological research, as the method is less invasive and therefore has less impact on the organisms' natural biological processes.

About the "Applied Photonics Award"

The "Applied Photonics Award" emerged from the "Green Photonics Young Scientist Award" - since 2018 with a new look and new content. It is organized by the Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena, Germany. The institute has been conducting application-oriented research in the fields of optics and photonics for over 25 years. As key technologies, these disciplines contribute to solving upcoming challenges for society, economy, and industry. In order to honor particularly original and innovative theses dealing with the topics of applied photonics, this young researcher award was created.

The "Applied Photonics Award" is presented in 2024 with the kind support of the Association of German Engineers (VDI), the State Development Corporation of Thuringia as well as the companies JENOPTIK, TRUMPF and Huawei Technologies.

Further information

- Official website of the Applied Photonics Awards: https://www.applied-photonics-award.de/

About Fraunhofer IOF

The Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena conducts application-oriented research in the field of photonics and develops innovative optical systems for controlling light - from its generation and manipulation to its application. The institute's range of services covers the entire photonic process chain from opto-mechanical and opto-electronic system design to the production of customer-specific solutions and prototypes. At Fraunhofer IOF, about 500 employees work on the annual research volume of 40 million euros.

For more information about Fraunhofer IOF, please visit: www.iof.fraunhofer.de

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