

# PRESS RELEASE

---

**PRESS RELEASE**March 02, 2021 || Page 1 | 4

---

**AlGaAs Bragg reflection waveguides offer great potential as source for entangled photons**

## **Fraunhofer IAF researches compact on-chip photon pair sources for quantum technologies**

**Fraunhofer IAF starts a project on compact on-chip sources for entangled photons, which are an important component for the realization of industrial quantum technology applications. In the project “QuoAIA”, scientists are researching waveguides based on aluminum gallium arsenide (AlGaAs) as sources for generating entangled photons. AlGaAs enables a particularly compact design and chip integration. The project started in February and is funded by the BMBF within the funding program “Quantum technologies—from basic research to market” as “WiVoPro” (Scientific Preliminary Project).**

Quantum technological applications are based on various quantum phenomena and physical laws to which elementary particles are subjected. These include the effect of entangled photons, on which promising concepts for high-precision sensor technology and secure quantum communication are based. In order to bring these technologies into application, compact and efficient sources of entangled photon pairs are needed that can be integrated into photonic circuits.

The main components of quantum photonic systems, such as mirrors, beam splitter and phase shifters, can all be realized in integrated form by now. However, this does not yet apply to the light sources and detectors that are required as well. “Our goal is now to integrate all the functions needed for quantum communication, i.e. the generation, manipulation and detection of single and entangled photons, into just one chip,” explains Dr. Thorsten Passow, project manager at the Fraunhofer Institute for Applied Solid State Physics IAF. The researchers are taking a first step with regard to light sources with the project “Quantum entangled photon pair source at telecom wavelength based on AlGaAs Bragg reflection waveguides (QuoAIA)”.

### **AlGaAs Bragg reflection waveguides as photon pair sources**

The focus of “QuoAIA” is on fundamental research of AlGaAs-based photon sources and their epitaxial fabrication. The aim is to generate photon pairs with a high quality of entanglement at an exactly defined wavelength. The target wavelength is 1550 nm, which is within the telecom range (1500-1600 nm).

---

**Editor****Stefanie Griesser** | Fraunhofer Institute for Applied Solid State Physics IAF |+49 761 5159-214 | Tullastrasse 72 | 79108 Freiburg, Germany | [www.iaf.fraunhofer.de](http://www.iaf.fraunhofer.de) | [stefanie.griesser@iaf.fraunhofer.de](mailto:stefanie.griesser@iaf.fraunhofer.de)

The semiconductor material AlGaAs is a promising material for photon pair sources for several reasons. For example, it has nonlinear properties. In a material with nonlinear properties, a photon can spontaneously split into two photons at high light intensity due to an optical effect. Such light particle pairs can be quantum mechanically entangled.

---

**PRESS RELEASE**March 02, 2021 || Page 2 | 4

---

### **Potential for particularly compact design**

Furthermore, AlGaAs Bragg reflection waveguides allow the integration of other optical and electronic components on chip level. "A unique feature of the technology used in the project "QuoAlA" is the potential to integrate a pump laser diode. This makes a particularly compact design possible," emphasizes Dr. Passow. By reducing the size, weight and power of the components, an essential requirement for the realization of practical applications would be met.

For use as a source in telecommunications, it must be possible to adjust the wavelength of the photons very precisely because the wavelength spacing of the channels is less than 1 nm. The wavelength of the generated photons depends very sensitively on the epitaxial produced layer structure of the waveguides. Therefore, the project focuses on the accuracy of the epitaxy of AlGaAs-based Bragg reflection waveguides with regard to the wavelength of the generated entangled photons.

The AlGaAs waveguide structures in the project benefit from the decades of experience of Fraunhofer IAF in the epitaxy of high-quality GaAs-based heterostructures as well as in process technology for the realization of waveguide structures in various III-V semiconductor materials. In addition, the scientists are using software for the optical simulation of Bragg reflection waveguides that they previously developed in the project "NESSiE".

The project "QuoAlA" is funded by the Federal Ministry of Education and Research within the framework program of the Federal Government "Quantum technologies—from basic research to market" as "WiVoPro" (Scientific Preliminary Project) (FKZ: 13N15480). The aim of these preliminary projects is to study scientific issues with regard to future industrial applications in photonics and quantum technology. They are intended to complement existing research funding and build a bridge between basic research and industry-led collaborative funding.

More information: <https://www.iaf.fraunhofer.de/en/researchers/optoelectronic-devices/quoala.html>

---

**About Fraunhofer IAF**

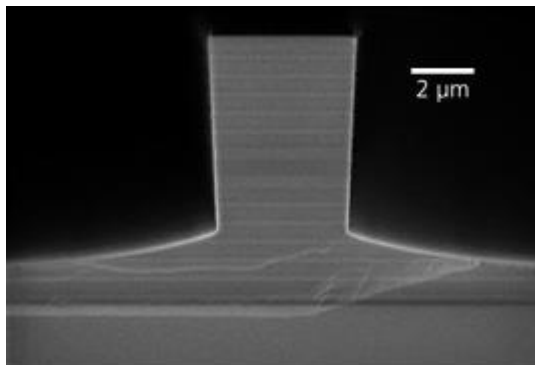
The Fraunhofer Institute for Applied Solid State Physics IAF is one of the world's leading research institutions in the fields of III-V semiconductors and synthetic diamond. Based on these materials, Fraunhofer IAF develops components for future-oriented technologies, such as electronic circuits for innovative communication and mobility solutions, laser systems for real-time spectroscopy, novel hardware components for quantum computing as well as quantum sensors for industrial applications.

With its research and development, the Freiburg research institute covers the entire value chain - from materials research, design and processing to modules, systems and demonstrators.

[www.iaf.fraunhofer.de/en](http://www.iaf.fraunhofer.de/en)

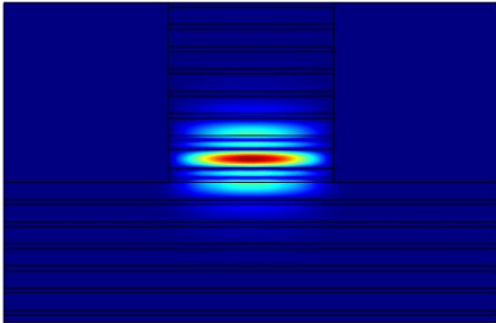
---

**Images:**



SEM image of the facet of a cleaved AlGaAs Bragg reflection ridge waveguide  
© Fraunhofer IAF

FRAUNHOFER INSTITUTE FOR APPLIED SOLID STATE PHYSICS IAF



Simulated profile of a Bragg reflection light wave mode in an AlGaAs Bragg reflection ridge waveguide © Fraunhofer IAF

---

**PRESS RELEASE**

March 02, 2021 || Page 4 | 4

---

---

The **Fraunhofer-Gesellschaft**, headquartered in Germany, is the world's leading applied research organization. With its focus on developing key technologies that are vital for the future and enabling the commercial exploitation of this work by business and industry, Fraunhofer plays a central role in the innovation process. As a pioneer and catalyst for groundbreaking developments and scientific excellence, Fraunhofer helps shape society now and in the future. Founded in 1949, the Fraunhofer-Gesellschaft currently operates 75 institutes and research institutions throughout Germany. The majority of the organization's 29,000 employees are qualified scientists and engineers, who work with an annual research budget of 2.8 billion euros. Of this sum, 2.4 billion euros is generated through contract research.