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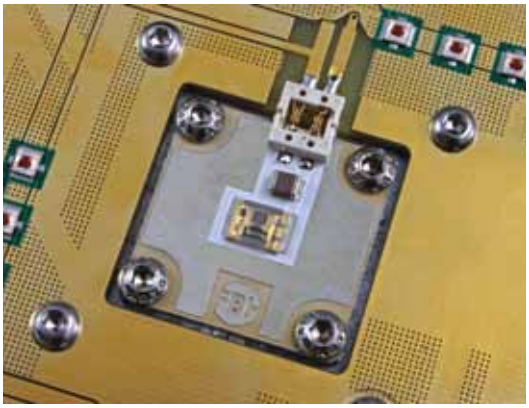


UV LED illumination systems for plants

customized light sources to enhance
health-promoting secondary plant metabolites

Competencies in UV LEDs and illumination systems

UV LEDs operate at low voltages with instant switching on/off. Moreover, the compact devices do not contain toxic substances and can be adapted precisely to meet the requirements of the respective application.

For the irradiation of plants, target wavelength and desired optical power have to be assured. Due to increased humidity and elevated temperatures in greenhouses and climate cabinets, hermetical packaging of the LEDs is as important as their stability during long-term operation. The FBH fabricates the suitable LEDs according to customer's specifications.

Exemplary illumination system with UV-B and visible LEDs

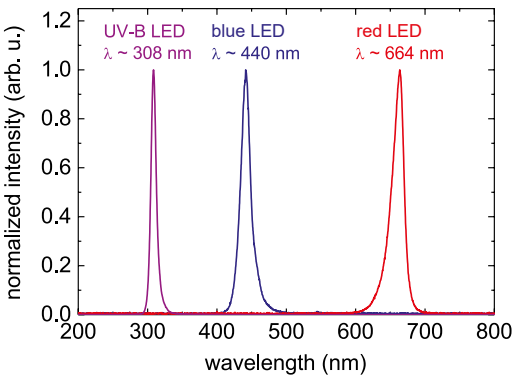
- Overall illumination area 0.5 m x 0.5 m with a uniformity of ~90 %
- High-power blue (440 nm) and red (664 nm) LEDs
- UV-B LEDs with peak wavelength 308 ± 5 nm
- At 35 cm distance: UV-B intensity 50 mW/m²

Corresponding to the UV activity spectrum of plants, UV-B LEDs with particular peak emission wavelengths in the range from 300 to 320 nm are available. LEDs with other wavelengths can be developed upon request.

Optimized illumination systems

Each system is designed in a way that ensures a uniform illumination of the plants. To achieve this, the intensity distribution below the illumination unit is simulated, taking into account the emission spectrum and the performance data of the LEDs. Fine-tuning of the uniformity is possible by adjusting the optical power of each LED individually. Efficient cooling ensures maximum lifetime of the UV LEDs.

Replication of different spectra, thus exposing plants to different triggers is possible since FBH uses its narrowband UV LEDs and combines them with red, green and/or blue LEDs. The optical power for each wavelength can be adjusted independently.



Exemplary spectra of red, blue and UV-B LEDs (left), high-power UV-B LED (right)

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User friendliness

The illumination units are designed for user-friendly operation in horticulture. An in-house developed software allows to set up automated sequences of irradiation cycles, controlled via wireless web server access.

Customized solutions on offer

FBH provides customized solutions and know-how as a one-stop agency – from design to ready-to-ship modules. The technological approaches for plant treatment with UV light comprise

- Epitaxial growth, chip processing and packaging of UV LEDs
- R&D of illumination systems using UV and visible LEDs
- Service and maintenance for FBH illumination systems

1 Software to program irradiation cycles individually for UV LEDs, red and blue LEDs

2 Preparation of plant samples for secondary metabolite analyses

Application of FBH irradiation modules in horticulture

IGZ and FBH have been developing various systems to grow plants under defined exposure to visible and UV-B light. In this process, the plant species itself, the required uniformity of the intensity of 80 – 100 %, the general growing conditions, and further demands of the horticultural production system have been considered. Within the cooperation, IGZ contributed with its know-how in plant breeding and its profound knowledge about irradiation cycles and doses as well as optimum climatic conditions. Activities were complemented by a comprehensive scientific evaluation of the resulting plant material. The FBH not only developed the required UV-B LEDs with the desired specifications, but also manufactured various irradiation modules according to IGZ's specifications.

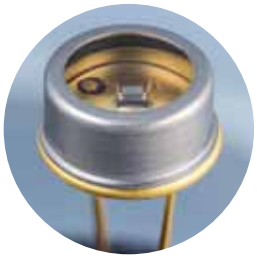
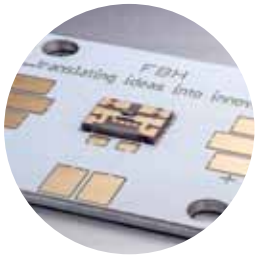
How UV-B LEDs help to increase health-promoting metabolites in food plants

Plant-derived nutrition contains secondary plant metabolites that trigger many health-promoting effects within the human organism, e.g., the digestive tract, the cardiovascular system and the immune system. This opens new perspectives for dietary prevention of immunologic processes such as inflammation and cancer development.

Upgrading vegetables in this way can be done by modification of secondary metabolite biosynthesis. An efficient elicitor application is the treatment with low doses of UV-B light – it does not damage the plants but results in the accumulation of secondary plant metabolites (e.g., flavonoids, carotenoids and glucosinolates) acting as antioxidants. The plant's short-term response is reflected by an increase of primary metabolites, which may act as precursors of UV-B-absorbing secondary metabolites that are synthesized later.

Profile IGZ

The Leibniz Institute of Vegetable and Ornamental Crops (IGZ) is investigating plant-environment interactions under physiological, molecular biological, metabolic and ecological aspects to promote sustainable production of vegetable and ornamental crops. Especially the Plant Quality and Food Security department is dedicated to functional examinations of secondary plant metabolites in selected vegetable species to improve food quality and food availability. IGZ is an extra-university research institute of the Leibniz Association bridging the gap between basic and applied research.

FBH – translating ideas into innovation

The Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (FBH) researches electronic and optical components, modules and systems based on compound semiconductors. These devices are key enablers that address the needs of today's society in fields like communications, energy, health, and mobility. Specifically, FBH develops light sources from the visible to the ultra-violet spectral range: high-power diode lasers with excellent beam quality, UV light sources, and hybrid laser systems. Applications range from medical technology, high-precision metrology and sensors to optical communications in space. In close cooperation with industry, its research results lead to cutting-edge products.

Advanced UV for Life – bundling competencies

FBH and IGZ have been cooperating within "Advanced UV for Life" for many years. In this consortium, research institutions and companies join their forces along the whole value chain of UV LED technology. The partners aim at pushing the technological boundaries and increasing the availability as well as the application of UV LEDs.

ADVANCED **UV** FOR LIFE

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