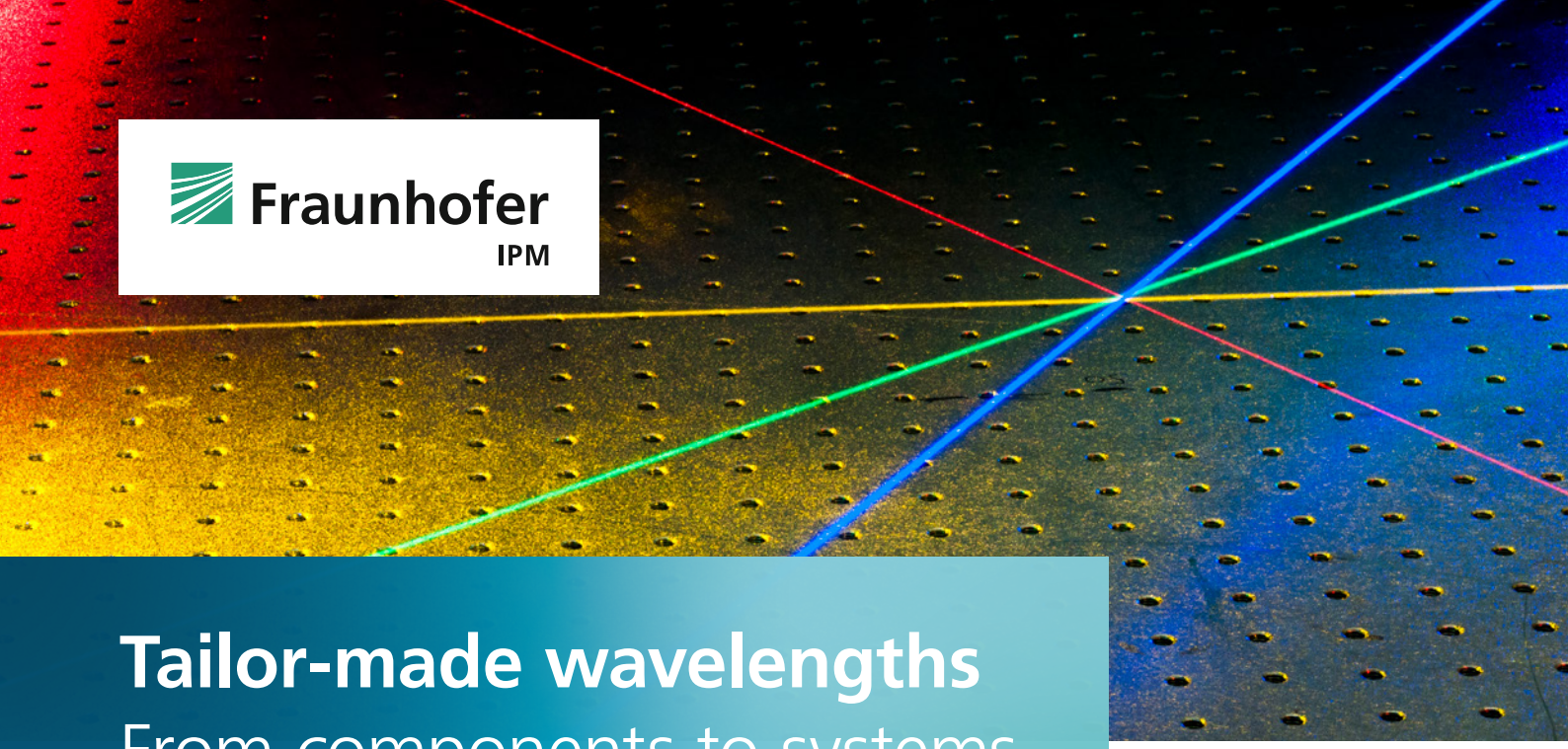
Fraunhofer IPM



Tailor-made wavelengths
From components to systems

Single-frequency, tunable, from UV to MIR

*Four **C-WAVE** beams tuned to different wavelengths. The continuous-wave OPO was developed by Fraunhofer IPM on behalf of HÜBNER PHOTONICS.*

Nonlinear-optical frequency conversion paves the way towards »tailor-made wavelengths« beyond the ranges of laser materials. Fraunhofer IPM has specialized in solutions for continuous-wave conversion. We cover the complete value chain from nonlinear optical components to turn-key light sources, supporting prototype development and offering customized turn-key systems for applications in science and industry.

Nonlinear-optical frequency conversion

Sometimes, just buying a laser is not enough to fulfill all spectral specifications required by an application. The »basic arithmetics« of nonlinear optical frequency conversion provide different ways of generating the desired wavelengths: Second harmonics (SHG), sum and difference frequency generation (SFG, DFG) transfer the stability and beam quality of single-frequency lasers into new wavelength regions. Optical parametric oscillators (OPO) provide wide tunability from a single-frequency source. Spontaneous parametric down conversion (SPDC) produces correlated or entangled photon pairs for applications like quantum sensing and quantum communication.

Sum frequency generation may also be used for MIR-to-NIR frequency upconversion to enable mid-infrared spectral information to be detected with fast and low-noise silicon detectors.

Covering the value chain

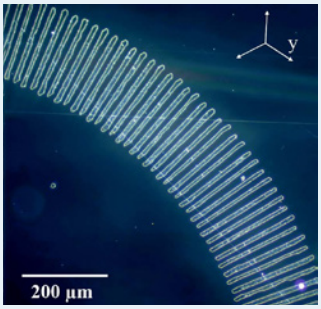
Fraunhofer IPM covers the complete value chain from the periodic poling of the nonlinear crystals up to delivering turn-key light sources. We provide solutions for customer-specific wavelengths combining different conversion processes. Different power levels can be addressed using bulk crystals or waveguides.

Efficient frequency conversion, however, is merely the first step towards turn-key light sources. It has to be complemented with a robust mechanical and optical setup including thermal management, low-noise and fast control electronics and a user-friendly interface or a seamless integration into the customer's ecosystem. Fraunhofer IPM develops solutions for all these areas in-house, allowing for short development cycles.

Our offer

We master the entire bandwidth of nonlinear-optical frequency conversion

- Single components
- Turn-key systems
- Short development cycles
- Robust opto-mechanical setup
- One of a kind or OEM product development
- Integration into customers' ecosystem

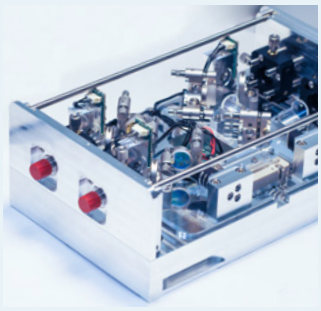


$LiNbO_3$ wafer structured by maskless poling

Nonlinear-optical components

Fraunhofer IPM has decades of experience in working with nonlinear optical materials. In-house developed fabrication and characterization techniques allow us to offer a variety of custom-made nonlinear-optical components and measurement services.

- Maskless periodic poling
- Waveguide design and fabrication
- Material characterization

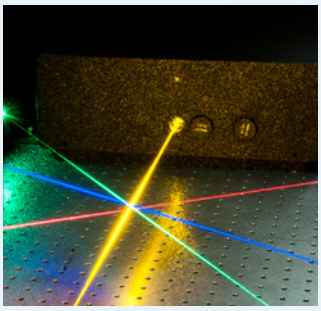


Module for MIR-to-NIR upconversion

Conversion modules

Fraunhofer IPM is known for its expertise in combining optics, mechanics and electronics. We integrate nonlinear optical components into robust conversion modules. From proof-of-principle demonstrators to prototype development for OEM applications – we provide solutions with short development cycles.

- Single-pass or resonant
- UV to MIR
- Waveguide or bulk crystals



Prototype »C-WAVE« OPO: widely tunable VIS-NIR source

Light sources

Turn-key tunable light sources combine state-of-the-art hardware with a user-friendly interface. With a strong focus on CW sources with output powers ranging from microwatt to multiwatt, we address the needs for both individual solutions for end users in science and industry as well as product development for OEM.

- Single-frequency or broadband
- OPO, SHG, DFG, SFG, SPDC
- Frequency combs

Highly sensitive transmission measurement system

Measurement systems

Laser-based measurement systems for metrology, imaging or analytical applications are at the core of our business. Solutions include the complete chain from light source to evaluation and management of measurement results within one device – including service.

- Turn-key systems for
  - spectroscopic and geometrical characterization
  - research and industry

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