



Fig. 3
New grades are continuously developed in the pilot plant
(Photo: SCHUPP® Ceramics)

Later followed the installation of a production line for high-temperature adhesives and heating elements at the Aachen site/

DE. Already at an early stage, concepts were developed with the top Japanese production partners ITM and JX, to be able to offer technical and economic solutions for furnace linings, insulating shapes or heating systems for special applications.

At the beginning of 2018 an important milestone was achieved for increasing the vertical range of manufacture with the commissioning of an in-house vacuum-forming system in Aachen for the production of PCW boards and shaped parts sold under the names UltraBoard and UltraVac (Fig. 1).

The project is running in partnership with the company ITM, which is contributing partly to the technology know-how. The investment is being made by SCHUPP® Ceramics.

The production plant has been designed in line with state-of-the-art environmental and safety standards. Insulation shapes can be machined in the dry state or consolidated by means of pre-firing at high temperature and then machined (Fig. 2). The goal is to produce three-dimensional shaped parts in Aachen. The plant design enables the pro-

cessing of various bulk wools. Individually developed recipes can be included in the range in future. A pilot plant is available for this purpose (Fig. 3).

SCHUPP® Ceramics wants to further develop and consolidate its position as a supplier for products with higher value creation, without impacting its existing product range.

In this way, the company is preparing to meet future market requirements for more complex geometries and higher quality standards. The production of the PCW components at the Aachen site enables more flexibility and shorter lead times.

With this investment, the company has increased the production area to 4000 m². Goal for business year 2018 is to reach sales of EUR 12 million with 55 employees. As improvement of the energy efficiency of high-temperature processes remains an important issue in the industry, SCHUPP® Ceramics sees for its business new applications that enable a diversification with UltraVac-formed parts made of polycrystalline mullite/alumina wool (PCW).

Optical Communication at Record-High Speed Thanks to Si_3N_4 Microresonators

Soliton frequency combs generated in optical microresonators allow to transmit data at rates of more than 50 terabits/s.

Researchers at Karlsruhe Institute of Technology (KIT) and École Polytechnique Fédérale de Lausanne (EPFL) have set a new record for optical data transmission. As reported in *Nature*, the team exploits optical solitons circulating in silicon nitride microresonators to generate broadband optical frequency combs.

Two such superimposed frequency combs enable massive parallel data transmission on 179 wavelength channels at a data rate of more than 50 terabits/s (DOI: 10.1038/nature22387).

Optical solitons are special wave packages that propagate without changing their shape. In optical communications, soli-

tons can be used for generating frequency combs with various spectral lines, which allow to realize particularly efficient and compact high-capacity optical communication systems. This was demonstrated recently by researchers from KIT's Institute of Photonics and Quantum Electronics (IPQ) and Institute of Microstructure Technology

(IMT) together with researchers from EPFL's Laboratory of Photonics and Quantum Measurements (LPQM).

As reported in *Nature*, the researchers used silicon nitride microresonators that can easily be integrated into compact communication systems. Within these resonators, solitons circulate continuously, thus generating broadband optical frequency combs. Such frequency combs, for which John Hall and Theodor W. Hänsch were awarded the Nobel Prize in Physics in 2005, consist of a multitude of spectral lines, which are aligned on a regular equidistant grid. Traditionally, frequency combs serve as high-precision optical references for measurement of frequencies. So-called Kerr frequency combs feature large optical bandwidths along with rather large line spacings, and are particularly well suited for data transmission. Each individual spectral line can be used for transmitting a separate data channel.

In their experiments, the researchers from Karlsruhe and Lausanne used two interleaved frequency combs to transmit data on 179 individual optical carriers, which completely cover the optical telecommunication C and L bands and allow a transmission of data in a rate of 55 terabits per second over a distance of 75 km. "This is equivalent to more than five billion phone calls or more than two million HD TV channels. It is the highest data rate ever reached using a frequency comb source in chip format," explains Christian Koos, professor at KIT's IPQ and IMT and recipient of a Starting Independent Researcher Grant of the European Research Council (ERC) for his research on optical frequency combs.

The components have the potential to reduce the energy consumption of the light source in communication systems drastically. The basis of the researchers' work are low-loss optical silicon nitride microresonators. In these, the soliton state described was for the first time generated by the working group around Prof. Tobias Kippenberg at EPFL in 2014. Explaining the

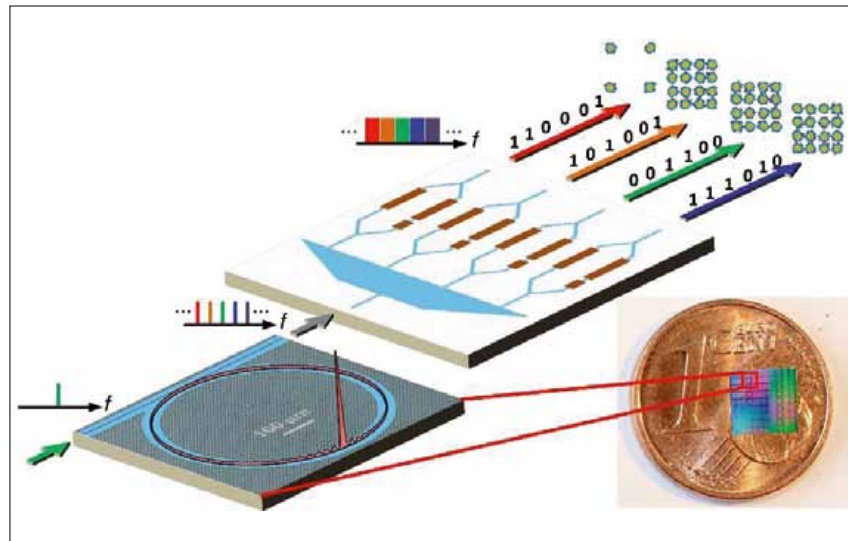


Fig. 1
Soliton frequency combs, generated in silicon nitride microresonators, are used for massively parallel data transmission via various frequency channels
(Photo: J. N. Kemal/P. Marin-Palomo/KIT)

advantages of the approach, Professor Kippenberg says, "Our soliton comb sources are ideally suited for data transmission and can be produced in large quantities at low costs on compact microchips." The soliton forms through so-called nonlinear optical processes occurring due to the high intensity of the light field in the microresonator.

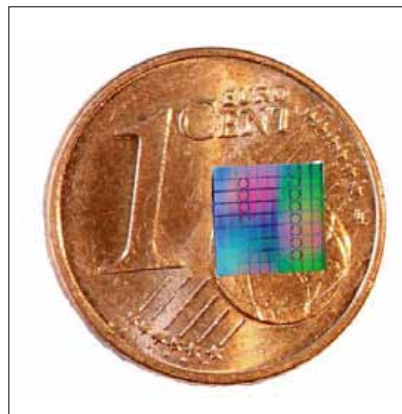


Fig. 2
Optical chip carrying a multitude of silicon nitride microresonators
(Photo: J. N. Kemal/P. Marin Palomo/KIT)

The microresonator is only pumped through a continuous-wave laser from which, by means of the soliton, hundreds of new equidistant laser lines are generated. The comb sources are currently being brought to application by a spin-off of EPFL.

The work published in *Nature* shows that microresonator soliton frequency comb sources can considerably increase the performance of wavelength division multiplexing (WDM) techniques in optical communications. WDM allows to transmit ultra-high data rates by using a multitude of independent data channels on a single optical waveguide. To this end, the information is encoded on laser light of different wavelengths. For coherent communications, microresonator soliton frequency comb sources can be used not only at the transmitter, but also at the receiver side of WDM systems. The comb sources dramatically increase scalability of the respective systems and enable highly parallel coherent data transmission with light. According to Christian Koos, this is an important step towards highly efficient chip-scale transceivers for future petabit networks.