World record in silicon integrated nanophotonics: More energy efficiency in the data communication

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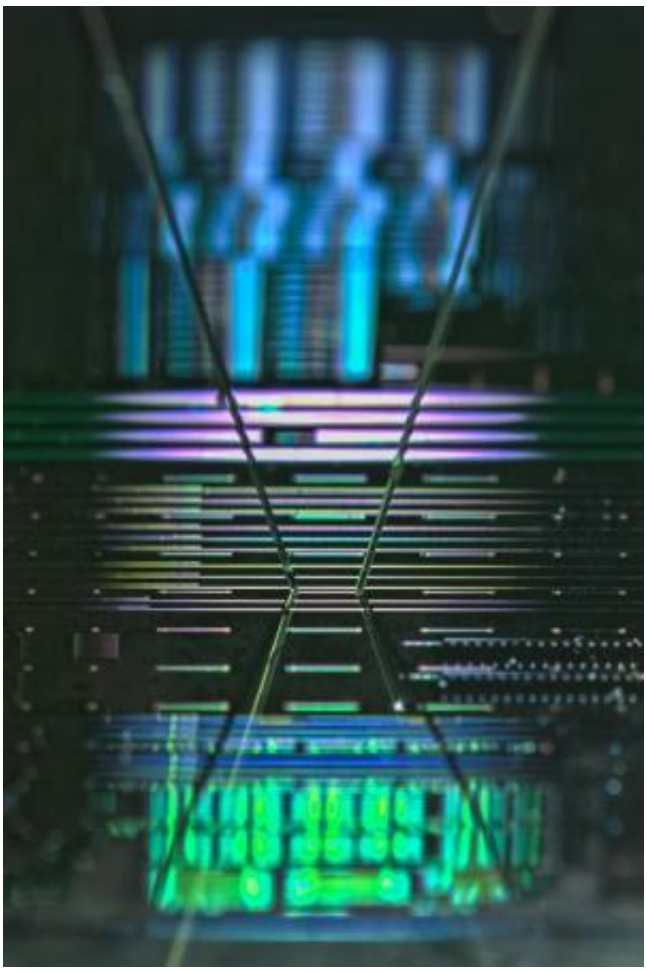

Researchers at the University of Stuttgart, Germany, achieved a new world record in the energy efficient integration in silicon. This is an important step to decrease the energy consumption of data transfer in internet and telecommunication. The researchers optimized aperiodic grating couplers in the nanometer range with a new developed backside metal mirror. Through this new method a record coupling efficiency of 87 percent between optical fibers and photonic integrated waveguides on silicon wafers has been achieved.

The internet and telecommunications are based on an optical core network that connects cities worldwide using glass fibers. These can carry light with very low losses over long distances. Based on a study published by CISCO, the mobile data transfer (smartphones) will solely increase from 885 petabytes per month (end of 2012) up to ten exabytes per month in the year 2017. To avoid a similar increasing energy consumption of our telecommunication systems, more efficient networks have to be developed, which represents nowadays a very interesting and actual research field.

Researchers of the INT and IMS CHIPS have developed a fabrication process to realize complex sender and receiver structures that are integrated on silicon wafers. Hitherto existing optical senders and receivers are based on indium phosphide substrates, which are available only in small dimensions and to very high costs. Experts predict that optical connections will be necessary in the home computer of the year 2020 to exchange the huge amount of data between individual components of the computer. The used light has a frequency of around 192 Terahertz and hence can offer bandwidths of several Terahertz and data rates beyond 1 Terabit/s. Thus, worldwide researchers try to develop new components to make use of these tremendous data rates in commercial products. Since silicon is transparent at the used light frequency, this material can be utilized in waveguiding structures. Computing based on photons in nanoelectronic circuits can be then

achieved in future computer components.

For this purpose light has to be efficiently guided in silicon waveguides and coupled from one component to another. The resulting energy losses have to be kept as small as possible. Researchers of the University of Stuttgart achieved a new world record in coupling efficiency between optical fibers and integrated silicon waveguides based on the new developed aperiodic grating coupler structures that are fabricated using the technology process of IMS CHIPS. With a record of 87 percent and a bandwidth of around 40 nm the new structures can pave the way for more efficient integration of optical senders and receivers in silicon.

In this complementary-metal-oxide-semiconductor fabrication process other components such as polarization beam splitters based on grating structures are also realized. The University of Stuttgart and IMS CHIPS achieved here as well promising results, which makes them leading in the integration of optical components in silicon. The researches will be concretized in commercial products with the support of industrial partners to achieve cost effective integrated senders and receivers in silicon that enable data rates beyond 1 Terabit/s.

More information: The results will be published in September at the European Conference on Optical Communications in London (www.ecoc2013.org/).

Provided by University of Stuttgart