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Professor Tae Joon Seok's joint research team develops the world's largest silicon optical switch that exceeds the semiconductor chip size limit

- GIST (President Kiseon Kim) – A joint research team led by Professor Tae Joon Seok of the School of Electrical Engineering and Computer Science and Professor Ming C. Wu UC Berkeley, USA, have succeeded in developing a new optical switch that can reconstruct the light information exchange through optical fiber more quickly and effectively than ever before.
 - The developed optical switch was implemented by integrating more than 50,000 nanostructures on a silicon semiconductor chip, which can reconfigure the connection between 240 optical inputs and 240 optical outputs using silicon semiconductor process technology. This is the world's largest optical integration switch.

- Online services such as e-mail, web search, online shopping, and social networking (SNS) that people use every day are all provided by computers (servers) in a data center. Hundreds of thousands of servers are connected to a network of fiber-optic networks to send and receive huge amounts of information.

- The network switch is responsible for managing the flow of information, which is currently being done by an electric signal-based network switch that generates a large amount of power consumption and heat, and the amount of information that can be processed will soon reach its limit. Optical switches will likely replace electric switches in the next-generation networks of the hyper-connection era, which is based on enormous amounts of information.

- Therefore, optical-intensive switches that can process light inside semiconductor chips and rearrange its path is actively being researched around the world. However, the optical integrated switches developed is limited by accumulating light loss due to its structure that has to go through switching stages as the number of inputs/outputs increases. In addition, the expansion of the switch size is limited due to the nature of the semiconductor process, in which the chip size (2 to 3 cm) is limited. As a result, only a few dozen optical input/output terminals can be processed in the conventional optical integrated switch.

- Instead of a conventional arrangement of multi-stage switching stages on a silicon optical semiconductor, the researchers implemented a multi-layered optical waveguide in three dimensions and physically moved the optical waveguide to a microelectromechanical system and avoided the accumulation of light loss. In addition, the world's largest optical integrated switch that can reconfigure 240 optical input/output connections was implemented by introducing a new method of connecting silicon chips in the optical semiconductor process. The switch can reconfigure more than a million input/output connections per second, which is more than a thousand times faster than conventional commercial optical switches that can be reconfigured about 100 times per second.

- GIST Professor Tae Joon Seok said, "The method of connecting the optical semiconductor chip introduced in this study is an innovative technology that enables a large-scale optical integrated circuit beyond

the size limit of a semiconductor chip, and it is expected to greatly affect next-generation large-scale optical circuits, such as optical-based processors, optical-based neural networks, as well as optically-intense switches."

- The research was led by Professor Tae Joon Seok of the School of Electrical Engineering and Computer Science and Professor Ming C. Wu UC Berkeley, USA, and was published on April 12, 2019 in *Optica* (IF=7.536), which is the fifth largest journal in the field of optics.

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