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Senior researcher Chul-Sik Kee's team is expected to utilize high-efficiency optical devices by developing a nano-planar structure that can trap light forever

□ GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) Advanced Photonics Research Institute (Director Young-rak Lee) senior researcher Chul-Sik Kee (Laboratory for Integrated Optics) has developed a metasurface*, a nano-planar structure that can be manufactured with nanotechnology and can trap light forever.

◦ The thin, planar meta-surface with a bound state in the continuum** that permanently confines light that was proposed by the research team can be applied to various high-density optical elements such as ultra-small semiconductor lasers and high-resolution optical filters.

* metasurface: Metasurface has the advantage of overcoming the limitations of traditional optical systems, such as having optical properties that natural materials cannot have, and producing high-resolution images that overcome diffraction limitations.

** bound state in the continuum (BIC): A quantum mechanical state in which electrons with a continuous level energy greater than the bound energy are spatially confined and was recently found in a state with light (photon) trapped forever in photonic crystals

- Existing studies on bound states in the continuum have been mainly performed using photonic crystals** including all Fourier-harmonized components*, but the results of the study on bound states in the continuum formation of meta-surface without specific Fourier-contaminated elements have been reported for the first time.

  * Fourier-harmonic components: multiples of frequencies corresponding to the periodic structure period

  ** photonic crystal: A structure whose refractive index changes periodically and strongly reflects light in a specific frequency range.

  - The research team conducted a theoretical study on the principle of the formation of a bound state in the continuum in photonic crystals and found that Fourier-harmonic elements independently influence the formation of a bound state in the continuum. In addition, it was found that the meta-surface manipulated with specific Fourier-harmonic components was useful for the formation of a continuous level bound state.

- Post-doc Sun-Goo Lee and senior researcher Chul-Sik Kee said, "This study is meaningful in understanding the relationship between the Fourier-harmonic component and the continuous level-bound state generation and suggests a fabricable metasurface from which the specific Fourier-harmonic component has been removed. The metasurface, which is a small and thin flat structure, can confine light not only in time, but also in tens of nano-spaces (spaces smaller than one-thousandths of a thousand of hair), so it can be expected to be used in the future development of nano lasers, high-sensitivity optical sensors, and quantum encryption communication technologies."

- This research by Dr. Sun-Goo Lee, Dr. Seong-Han Kim, and senior researcher Chul-Sik Kee was supported by the Ministry of Science and ICT, the Ministry of Education, and the GIST Research Institute and was published online on January 4, 2021, in the internationally renowned journal *Physical Review Letters*.

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