*** 北米連携センター情報***

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●ミネソタ大学、音で光を制御するチップを開発

【University of Minnesota, 2014/11/26】

ミネソタ大学工学部の研究チームは光と音を生成し、音によって光を極めて効率よく制御できるチップを開発したことを、Nature Communications 誌上で発表した。この新型チップは、光ファイバを使う無線通信システムを改善し、量子コンピュータへの応用も可能だという。

チップは、シリコンの基盤に窒化アルミニウムの層を設け、この層に交流電気を流すことで素材の定期的な変形を促し、音を生成する。この手法は、携帯電話などでマイクロ波フィルタに使われているが、今回の研究の大きな成果は音響デバイスと同じ層に光回路を統合した点。

また、幅わずか 100nm の電極を使って 10GHz 超の音波を生成することに成功しており、波長が光波よりも短い音波によって高速な変調を実現した。

この研究には全米科学財団（NSF）と空軍科学研究所が資金を提供している。

（参考）本件報道記事

University of Minnesota engineers make sound loud enough to bend light on a computer chip

Device could improve wireless communications systems

November 26, 2014

During a thunderstorm, we all know that it is common to hear thunder after we see the lightning. That's because sound travels much slower (768 miles per hour) than light (670,000,000 miles per hour).

Now, University of Minnesota engineering researchers have developed a chip on which both sound wave and light wave are generated and confined together so that the sound can very efficiently control the light. The novel device platform could improve wireless communications systems using optical fibers and ultimately be used for computation using quantum physics.

The research was recently published in Nature Communications, a leading research journal.

The University of Minnesota chip is made with a silicon base coated with a layer of aluminum nitride that conducts an electric change. Applying alternating electrical signal to the material causes the material to deform periodically and generate sound waves that grow on its surface, similar to earthquake waves that grow from the center of the earthquake. The technology has been widely used in cell phones and other wireless devices as microwave filters.

"Our breakthrough is to integrate optical circuits in the same layer of material with acoustic devices in order to attain extreme strong interaction between light and sound waves," said Mo Li, assistant professor in the Department of Electrical and Computer Engineering and the lead researcher of the study.

The researchers used the state-of-the-art nanofabrication technology to make arrays of electrodes with a width of only 100 nanometers (0.00001 centimeters) to excite sound waves at an unprecedented high frequency that is higher than 10 GHz, the frequency used for satellite communications.

"What's remarkable is that at this high frequency, the wavelength of the sound is even shorter than the wavelength of light. This is achieved for the first time on a chip," said Semere Tadesse, a graduate student in the University of Minnesota's School of Physics and Astronomy and the first author of the paper. "In this unprecedented regime, sound can interact with light most efficiently to achieve high-speed modulation."

In addition to applications in communications, researchers are pursuing quantum physics applications for the novel device. They are investigating the interaction between single photons (the fundamental quantum unit of light) and single phonons (the fundamental quantum unit of sound). The researcher plan to use sound waves as the information carriers for quantum computing.

The research is funded by National Science Foundation and Air Force Office of Scientific Research. The device was fabricated in the cleanroom at the Minnesota Nano Center at the University of Minnesota.

To read the full article, entitled "Sub-optical wavelength acoustic wave modulation of integrated photonic resonators at microwave frequencies," visit

the Nature Communications website.

Source: http://discover.umn.edu/news/science-technology/university-minnesota-engineers-make-sound-loud-enough-bend-light-computer

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