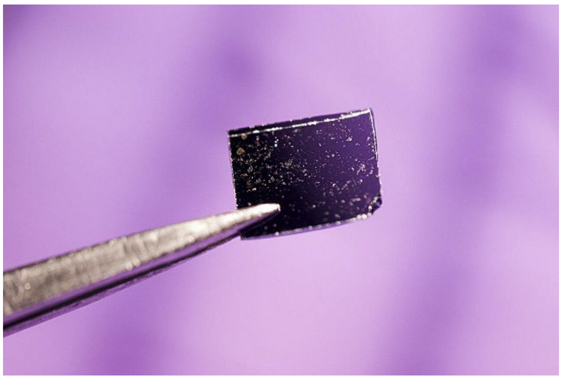
科学网
ScienceNet.cn
新闻

17 October 2024

English translation

Van der Waals stacking technique creates entangled photon pairs

Scientists from Nanyang Technological University, Singapore, have developed a new technology that uses ultra-thin niobium dichloride oxide (NbOCl2) sheets with a thickness of only 1.2 microns to generate entangled photon pairs required for quantum computing, which is expected to reduce the size of key components to one thousandth of the original size. This achievement represents a new direction for the application of van der Waals force stacking technology. The relevant paper was published in Nature Photonics on the 14th.



NbOCl2 thin sheets. Image source: Nanyang Technological University, Singapore

The researchers explained that compared to electronic qubits that require ultra-low temperatures, photons as qubits can operate at room temperature, which has a unique advantage. When photons are generated in the form of entangled pairs, they can maintain quantum states and perform multiple calculations simultaneously at a faster speed. However, one of the biggest obstacles to using photons is the difficulty of generating enough entangled photon pairs, especially when using thinner materials.

To solve this problem, the research team used NbOCl2 material with special optical properties. They stacked two ultra-thin sheets of the material together and aligned their grains vertically, successfully creating entangled photon pairs without the need for additional synchronization equipment. This makes it possible to develop scalable and efficient quantum photonic systems, and is expected to integrate quantum technology directly into chip-based platforms.

Van der Waals engineering is a technique for adjusting material properties by stacking two-dimensional materials, and has been used in applications ranging from superconductivity to the fractional quantum anomalous Hall effect. The key to the success of this research lies in the innovative stacking technology, which stacks two ultra-thin $NbOCl_2$ at a perpendicular angle to achieve polarisation entanglement - a basic requirement for quantum computing. According to the team, polarisation-entangled photon pairs have been the basis of quantum optics experiments for decades, but they usually require the use of larger and bulkier materials. Through van der Waals engineering, polarisation-entangled photons can be generated without these large devices.

By stacking thin sheets of material, the research team generated photon pairs with high quantum coherence. They measured the fidelity of the polarisation entangled state to be 86%, which shows that van der Waals force engineering methods may be a reliable way to create quantum entangled states and integrate quantum photonic devices directly into chips.

This application of van der Waals engineering may have an impact not only on quantum computing, but also on secure communications and other quantum technologies. If quantum components are reduced to one thousandth of their current size, it is expected to lead to more compact, scalable and energy-efficient quantum systems.

https://news.sciencenet.cn/htmlnews/2024/10/531771.shtm