Communi-cation / Info

Single-photon emitter based on optical fiber

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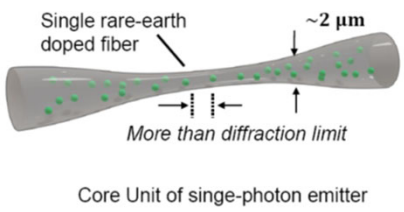
Purpose of Research

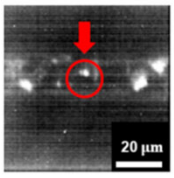
Single photon light sources are known to be fundamental technologies in quantum information technologies such as true random number generators, quantum cryptographic communications, ultra-high resolution image analysis, and optical quantum computers. We will realize a relatively low-cost single-photon light source with selectable wavelengths and without the need for a cooling system by using an optical fiber doped with optically active rare-earth atom.

Summary of Research

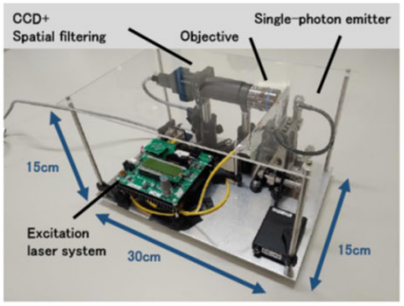
Single photon sources using crystalline materials are expensive to manufacture and operate, and it is difficult to select the wavelength at which a single photon is generated and generally require a cooling system. In contrast, we have realized a single rare-earth atom state in an optical fiber with optically active rare-earth atoms at room temperature, and succeeded in generating a single photon by excitation of this single rare-earth ions in tapered optical fiber.



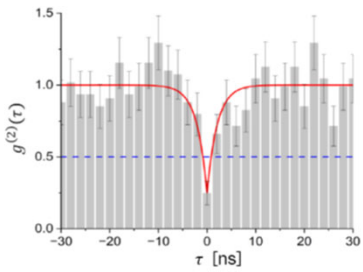
Core Unit of singe-photon emitter



CCD image of singe-photon emission



Outlook of single-photon emitter



Experimental evidence of single-photon emission

Comparison with Conventional or Competitive Technologies

Wavelength selectable and operates at room temperature at low cost.

Expected Applications

A cryptographic key distribution device, which is necessary to improve security in quantum cryptographic communications.

Challenges in Implementation

Telecommunication wavelengths has not yet been solved. Generation efficiency needs to be improved by cavity technology.

What We Expect from Companies

We are seeking research and technical cooperation to develop single-photon light sources at telecommunication wavelengths and to improve their generation efficiency.

Points

- Low-cost for manufacturing
- Easily generate single-photons at various wavelengths
- Possible to generate at room temperature

Future Developments

2025.4 Realization at telecommunication wavelengths

2026.4 Realization with practical generation efficiency using resonators

■ Patent：JP Appl. 2021-089181
■ Prototype：Yes

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