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# 次世代超高速・大容量無線通信に向けた室温動作テラヘルツ量子カスケードレーザーの研究

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# Development of room-temperature operating terahertz quantum cascade lasers for next-generation wireless communications

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## 研究概要

The development of next-generation ultrafast wireless communication technologies (beyond 5G, 6G/7G) becomes a central competition among nations. Japan has outlined the blueprint of “2030 society”, emphasizing the crucial role of these communications technologies. The transmission waves are expected to extend from millimeter band to terahertz (THz, frequency ＞ 100 GHz, or ＞ 0.1 THz) for these new technologies. In this spectral domain, the data transmission speeds can be 10~100 times faster than 5G. The successful realization of this advancement relies on the availability of a compact THz wave radiation source that can be seamlessly integrated into network infrastructures, especially for frequencies exceeding 2 THz. In fact, there are high enthusiasms to develop such THz sources based on semiconductors devices and expect comparable successes as that in visible light frequencies by LEDs or LDs. In pursuit of this goal, quantum cascade lasers, employing the unipolar carriers intersubband transition, show promises. However, the practical deployment of these lasers is still confined in laboratory due to the essential of heavy cooling packages and limited output powers, i.e., only sub-milliwatt level. This proposal aims to achieve micrometer-sized quantum cascade lasers that capable of operating at room-temperature without any cooling, while deliver a substantial average output power exceeding 10 milliwatts. The research will focus on finding new active-region designs with high robustness on elevated temperatures, ensuring high-quality and consistent epitaxy of quantum structures, re-optimizing and fabricating waveguide structures.