

電子物理工学セミナー

Special Seminar in Physics and Electronics Dept.

by 熊谷崇 **Takashi Kumagai**

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15:00-16:30

於：B4棟

西K102

Title

**Tip-Enhanced Nano-Spectroscopy
for Single Atoms, Molecules, and Nanomaterials**

Abstract

I will present our recent research spanning from tip-enhanced Raman spectroscopy (TERS) in picocavities to ultrafast nanospectroscopy in low-dimensional materials [1–7]. Picocavity TERS enables not only chemical analysis at the single-atom and single-molecule level, but also access to atomically confined light–matter interactions that are inaccessible by conventional techniques. In ultrafast nanospectroscopy, we have visualized coherent dynamics at the atomic scale, as well as spatially inhomogeneous carrier dynamics characteristic of low-dimensional materials. These approaches reveal direct causal relationships between local structures (such as defects), electronic states, and their interactions with the surrounding environment—relationships that are typically obscured by spatial averaging in conventional measurements. Based on these results, I will discuss future directions for tip-enhanced near-field spectroscopy.

References

- [1] T. Kumagai, K. Miwa, B. Cirera, *Nano Lett.* **25**, 15449 (2025).
- [2] A. Shiotari *et al.* *Phys. Rev. Lett.* **134**, 206901 (2025).
- [3] J. Nishida *et al.* *Sci. Adv.* **11**, eadv9584 (2025).
- [4] J. Nishida *et al.* *Nano Lett.* **24**, 836 (2024).
- [5] S. Liu *et al.* *ACS Nano* **17**, 10172 (2023).
- [6] S. Liu *et al.* *Sci. Adv.* **8**, eabq5682 (2022).
- [7] B. Cirera *et al.* *ACS Nano* **16**, 16443 (2022).