レンセラー工科大学 － 北海道大学 共催

第 4 回 RPI–HU 共同セミナー
“RPI-HU joint seminar on advanced semiconductor and related technologies for future communication and computing”

2024 年 8 月、本学は、レンセラー工科大学*（米国：ニューヨーク州）と、半導体分野における人材育成・研究活動での協力を共に検討していくための合意書を締結しました。研究者レベルでの技術交流を活発化し両大学の連携を一層強化することを目的に、RPI – HU 共同セミナー・シリーズを企画しましたのでご案内いたします。今回は 4 回目の開催となり、Jian Shi 教授（レンセラー工科大学 Dept of Materials Science and Engineering）と足立智 教授（北海道大学 大学院工学研究院応用物理学部門）の双方から、最新の研究内容を紹介していただきます。本学教員の皆さんをはじめ、研究員・学生の皆さんも聴講可能ですので、お誘い合わせの上、ぜひご参加ください。

*レンセラー工科大学: Albany NanoTech Complex、IBM など、地域の半導体主要機関と緊密な関係を有し、半導体分野における教育及び研究において先進的な取り組みを行なっています。

開催概要

「第 4 回レンセラー工科大学-北海道大学共同セミナー」

日時：2025 年 10 月 29 日（水）8：00～9:00

形式：オンライン-Webex meeting（事前受付不要）

https://hokudai.webex.com/hokudai/j.php?MTID=mba4738f42b0da5560b276e93f571d8a7

Meeting ID: 2517 366 8305, Pass code: MMpRGZTG232

講演内容

“Exploration of ZEFOZ transitions and spin wave storage in $^{167}Er:Y_2SiO_5$ for telecom quantum memory”

Prof. Satoru Adachi, *Hokkaido University, JAPAN*

Abstract: Recently, quantum repeaters and quantum memories (QMs) have been extensively investigated for realization of global quantum information networks. QMs play an important role in the coherent, efficient, and reversible transfer of quantum information between light and matter. In particular, isotopically pure $^{167}Er^{3+}$: Y_2SiO_5 (YSO) crystal is a promising QM platform owing to its zero-phonon transition in the telecom-band (~1.536 mm), ideal Λ-type three-level system, and relatively long coherence time. The Atomic Frequency Comb (AFC) QM protocol based on photon echoes is easy to use, and its memory efficiency strongly depends on the number of electrons constituting the AFC, making samples doped with high Er concentrations preferable. Conversely, samples with lower Er density are preferred for achieving long storage times. This is because spin-flipl-induced magnetic fluctuations, driven by nuclear spins in the host YSO and the doped Er electron spins, are the primary cause of spin decoherence. Applications must resolve this tradeoff between memory efficiency and storage time. As a topic presentation in the seminar, I will introduce very preliminary experimental and simulation results on this subject.

“Switchable Spin-Momentum Relations in Dresselhaus Semiconductors”

Prof. Jian Shi, *Rensselaer Polytechnic Institute, USA*

Abstract: Quantum well structures lacking inversion symmetry host a plethora of exciting physical phenomena. In this talk, we show the design, creation, and electron-spin-lattice interactions of quantum well polar materials for spintronics and energy transduction. First, we show the role of dimensionality on the phonon and polarization dynamics of free-standing two-dimensional membranes. Then, we show the discovery of the persistent spin helix in a hybrid ferroelectric perovskite with a natural quantum well structure. We demonstrate that the spin-polarized band structure is switchable at room temperature via an intrinsic ferroelectric field. The favored short spin helix wavelength (three orders of magnitude shorter than in IIIØCV materials), room-temperature operation and non-volatility make the hybrid perovskite an ideal platform for understanding symmetry-tuned spin dynamics, towards designing spintronic or spin-orbit qubit materials and devices that can resolve the control-dephasing dilemma.

セミナー世話人

Prof. Christian M. Wetzel, *Rensselaer Polytechnic Institute, USA*

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