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IAPME Seminar

Room-Temperature Waveguide Integrated Quantum Register in a Semiconductor Photonic Platform

6 December 2024

Prof. Yu ZHOU
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Venue: N23-4018
Time: 14:00 - 15:00
Hosted by: Prof. Shen LAI

Abstract

Quantum photonic integrated circuits are reshaping quantum networks and sensing by providing compact, efficient platforms for practical quantum applications. Despite continuous breakthroughs, integrating entangled registers into photonic devices on a CMOS-compatible platform presents significant challenges. Herein, we present single electron-nuclear spin entanglement and its integration into a silicon-carbide-on-insulator (SiCOI) waveguide. We demonstrate the successful generation of single divacancy electron spins and near-unity spin initialization of single ^{13}C nuclear spins. Both single nuclear and electron spin can be coherently controlled and a maximally entangled state with a fidelity of 0.89 has been prepared under ambient conditions. Based on the nanoscale positioning techniques, the entangled quantum register has been further integrated into SiC photonic waveguides for the first time. We find that the intrinsic optical and spin characteristics of the register are well preserved and the fidelity of the entangled state remains as high as 0.88. Our findings highlight the promising prospects of the SiCOI platform as a compelling candidate for future scalable quantum photonic applications and Nature Communications recently accepted this work.

Biography

Dr. Yu ZHOU is an outstanding young professor and doctoral supervisor at the Harbin Institute of Technology, Shenzhen. He earned his Bachelor‘s degree from Xi’an Jiaotong University in 2014 and his Ph.D. from Nanyang Technological University, Singapore, under the mentorship of Prof. Gao Weibo in 2019. Dr. Zhou also served as a senior researcher at Tencent's Quantum Lab.

Dr. Zhou's research expertise lies in quantum defects and nano-optics, where he has made significant contributions with high-impact SCI publications. Notably, he has published ten first/corresponding author high-impact SCI papers, including 4 Nature Communications, 1 Science Advances, and a featured cover article in Photonics Research in 2024.

Dr. Zhou has been instrumental in securing and leading key research projects, such as the Youth Fund of the National Natural Science Foundation of and the Guangdong Province Quantum Strategy Special Project (2 million RMB). He has also been honored as the 9th recipient of the China Association for Science and Technology Young Talent Support. He has been recognized in Forbes' 30 Under 30 list for his work in technology.

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