



Contribution ID: 210

Type: Poster

Development of WSi Superconducting Nanowire Single Photon Detectors

Thursday 4 December 2025 15:10 (1 hour)

The detection of infrared photons is critical to the successful readout of single photon states of spin qubit platforms such as embedded ions. Superconducting nanowire single photon detectors (SNSPDs), based on the simple principle of the generation of a hotspot in a superconducting nanowire upon photon absorption leading to a resistance spike, provide an excellent platform for fast and efficient detection of infrared photons. SNSPDs have been shown to achieve near unity efficiency including at the critical telecommunication wavelength of 1550 nm, with extremely low near-zero dark counts, low reset times and low jitter. Tungsten silicide (WSi) is a common choice of nanowire material since it has a high internal efficiency, is amorphous in nature and allows for embedding of the material inside an optical stack to enhance absorption.

Here, we report the development of WSi films for nanowire fabrication and incorporation into SNSPDs which will be fabricated and tested in-house. We report the resistance of these films as well as their critical temperature, marking their transition to a superconducting state at cryogenic temperatures, for films sputtered onto a variety of substrate surfaces, such as silicon and silicon oxide. We then report on their inclusion into optical stacks for full SNSPD devices optimized for 1550 nm photon detection. Finally, we report an outlook on how these SNSPDs can enable ultrafast measurement of spin qubit systems such as embedded rare-earth ions.

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Session Classification: Poster Session

Track Classification: Topical Groups: Condensed Matter & Materials