Superconducting diamond devices: The advantages of nanocrystalline diamond

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To understand new superconductors, it is usually a good idea to start with the best samples that you can to understand the basic material properties, which often means high quality single crystal samples. For practical reasons, the best samples are sometimes not particularly useful when it comes to device applications. So, why would you ever want a 'bad' superconductor?

In this talk, I will discuss why not all 'bad' superconductors are bad, using our progress in nanocrystalline superconducting diamond devices as an illustration. I will present some selected results – including SQUIDs [1], cryogenic memory devices [2], and microwave resonators [3] – and discuss how the microstructure of nanocrystalline diamond enables and facilitates their operation.

Finally, I will present some open questions that have arisen from the study of this fascinating superconductor and discuss some of our early progress in the low temperature characterization of diamond substrates.

[1] M. Bose et al., *"Low-noise diamond-based DC nano-SQUIDs."* ACS Applied Electronic Materials 4, no. 5 (2022): 2246-2252.
[2] G. M. Klemencic et al., *"Phase slips and metastability in granular boron-doped nanocrystalline diamond microbridges."* Carbon 175 (2021): 43-49.
[3] J. A. Cuenca et al., *"Superconducting boron doped nanocrystalline diamond microwave coplanar resonator."* Carbon 201 (2023): 251-259.