# Diamond scanning probes for nanoscale scanning thermal imaging using NV centers

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The ability to measure temperature with nanoscale spatial resolution has become key in a broad range of fields like materials science, electronics, chemistry, and life sciences. In the past years,several techniques have been used including scanning thermal microscopy (SThM), thermo-reflectance and Raman spectroscopy. Unfortunately, these techniques fail on delivering simultaneously sensitive and quantitative thermal imaging with a sub-micron spatial resolution under ambient conditions and simple use. In recent years, nanoscale thermometry based on Nitrogen-Vacancy (NV) electronic spins in nanodiamonds has emerged as a strong candidate to overcome the challenges encountered by aforementioned techniques ([1], [2]). The main challenge, however, comes from the fact that nano-diamonds are spread randomly over a sample of interest, which forbids the deterministic acquisition of spatial information during thermometry measurements.

In this talk, we present numerical analysis that clearly identifies the limitations in the use of bulk diamonds in nano-thermometry measurements and suggest that engineered heterostructures must be designed to truly achieve non-invasive spatially resolved nano-thermometry with performance similar as nanodiamonds. We present a novel approach in the fabrication of diamond-based scanning probes containing NV centers that are optimized for nano-thermometry imaging experiments. These devices offer a unique combination of tip robustness, high sensitivity, quantitative sensing, and nanometer resolution to scanning thermometry. Our approach will enable measurements of hot spots in materials with high thermal conductivity such as metallic feed lines in microelectronic devices that could not be measured before due to limitations of the existing technologies.

## References

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