Two-qubit [Dy_2] molecules deposited into micro-SQUID susceptometers: in situ characterization of their spin response

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The integration of magnetic molecules into superconducting circuits is key for developing hybrid quantum computing architectures [1-4]. Here, we study [Dy_2] molecular dimers deposited onto micro-SQUID susceptometers. The results of magnetic and heat capacity experiments, backed by theoretical calculations, show that each [Dy_2] dimer can act as a two-qubit quantum processor. Arrays of [Dy_2] molecules have been optimally integrated inside the 20 μm wide loops of micro-SQUID sensors by means of Dip-Pen Nanolithography [5]. The equilibrium magnetic susceptibility and the spin tunneling dynamics measured in situ evidence that these molecules preserve the spin ground states, magnetic interactions and magnetic asymmetry that characterize them in bulk. These results show that it is possible to interface multi-qubit molecular complexes with superconducting circuits without disturbing their relevant properties and hints at the potential of soft nanolithography to achieve this goal in practice.

References

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Figures

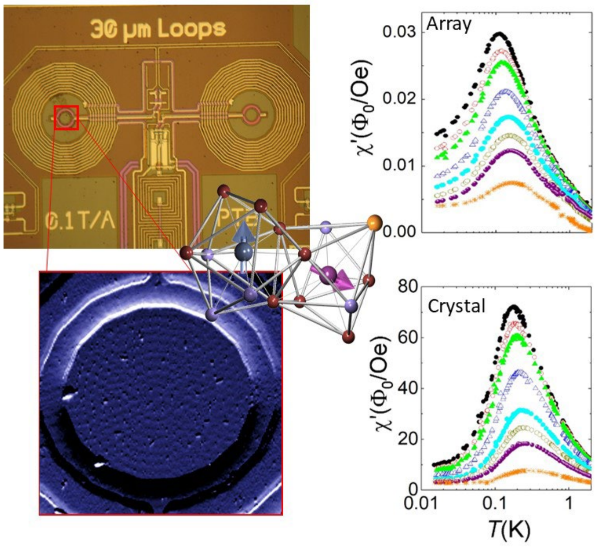

Figure 1: Image of a micro-SQUID ac susceptometer (top left) and of a [Dy_2] nanoarray deposited on one of its pick-up coils (bottom left). Linear ac susceptibility measured on an array (top right) compared to that measured on a bulk crystal (bottom right).