High-T_c Josephson junctions for quantum computation

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Abstract

So far, almost exclusively, Josephson junctions made of low transition temperature (low-T_c) superconductors like Al have been used for the implementation of superconducting qubits for quantum computation. This is because low-T_c junctions have superior performances and their fabrication technology is far more advanced relative to the case of junctions made of high transition temperature (high-T_c) superconductors such as YBCO. However, unlike low-T_c superconductors, high-T_c superconductors are d-wave superconductors and this feature offer the possibility to naturally build π–loops-based qubits. Indeed, high-T_c junctions have been proposed as excellent candidates for device implementation of circuits based on π–loops in quantum computing with [1] or without [2] the topological restriction imposed by the bicrystal technique. Several recent very significant developments in the area of high-T_c junctions fabrication [3, 4] and their improved sensitivity [5] opens the possibility to reconsider their use for quantum computation. Indeed very significant progress has been reported in the area of step-edge junction technology [4, 5] that offers the advantage of using low cost MgO substrates and the flexibility of implementing complex 2D large array configurations involving many tens of thousands of SQUIDs. Also in [5] the white flux-noise performances of high-T_c SQUID-arrays operating above 77K and fabricated using the bicrystal technology outperformed even single low-T_c –SQUIDs operating at 4.2 K.

References

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