Simulation and Measurement of HTS Josephson Heterodyne Oscillator

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Abstract—We report continuing investigations into practical applications of the ac Josephson effect as the basis for a voltage-tunable radio-frequency oscillator. We have previously demonstrated experimentally that useful power levels (10s of nW) and linewidths of a few kHz can be achieved in the heterodyne output from a High-Temperature-Superconducting Resistive SQUID (HTS-RSQUID) operating in the frequency range 1 – 50 MHz. Those results were achieved with 2-junction R-SQUIDs incorporating current-biased shunt resistors of a few micro-ohms. We have now modified the fabrication procedures, and adjusted the shunt resistors and bias current values so that higher frequencies can be achieved. The Josephson junctions are of step-edge type, rather than the bi-crystal type used in our earlier work. The step-edge technique permits much more flexibility in the geometrical lay-out and utilises the more cost-effective single-crystal MgO substrates. In the present paper, we report numerical simulations and experimental measurements on these devices in the frequency range up to 2 GHz.

Index Terms — Heterodyne oscillator, Josephson junction, High-Temperature-Superconducting.

Manuscript received 19 August 2008.
This work was supported in part by the CSIRO, Australia, and Mesaplexx Pty Ltd, Australia.
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