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NASA TECH BRIEF

Marshall Space Flight Center

Superconducting Quantum-Interference Devices

A document has been published discussing superconducting quantum-interference devices (SQUID's). All of these devices are based on weak-link Josephson elements that join the superconductors. The links can take numerous forms, and the circuitry utilizing the links can perform many varied functions with unprecedented sensitivity. For example, voltages as small as 10^{-15} volt can be measured with these devices, and far-infrared signals from distant galaxies can be detected.

The document includes a brief theoretical review of Josephson's junctions. These include tunneling junctions, point contact devices, microbridges, and proximity-effect devices. The latter two have greater mechanical stability and can be developed in smaller packages. The devices have many potential applications, depending on the design sophistication. At this stage, the devices have been used for measuring voltages, electromagnetic radiation, and magnetic fields. A partial listing of the applications is presented in the table.

The document also discusses the method of manufacturing microbridges of submicron widths. The basic steps include:

a. The deposition of niobium film by bias sputtering,
b. The overcoating of the niobium with a plastic electron resist, and
c. The development of the bridge pattern by exposure using a scanning electron microscope.

The pattern is used to protect appropriate areas during RF sputter etching.

Partial Listing of Applications of Weak-Link Devices

Application	Advantages
1. Magnetometry	World's most sensitive, 10^{-19} weber or less.
2. Electrical Metrology a. Maintain legal volt b. Measure current c. Measure voltage d. Measure attenuation ratio	Unprecedented sensitivity from dc through the microwave range.
3. Far-Infrared and Millimeter-Wave a. Receivers b. Harmonic mixers c. Spectrum analyzers	Highest sensitivities; mixing unattainable by any other device; high stabilities possible.
4. Other a. Null detectors b. Amplifiers c. Thermometers d. Photon generators and detectors	Highest sensitivities; low thermal noise; choice of impedance.

(continued overleaf)

Note:
Requests for further information may be directed to:

Technology Utilization Officer
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Patent status:
NASA has decided not to apply for a patent.

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Categories: 03 (Physical Sciences)
01 (Electronics - Components and Circuitry)
08 (Fabrication Technology)