II-1 THE SUPERCONDUCTING RESONATOR - A NEW MICROWAVE COMPONENT

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The surface conductance of superconductors in the frequency region of microwaves is by several orders of magnitude higher than that of normalconducting copper. This can be well understood from the two-fluid model of the superconductors and the non-local behaviour of the metallic electrons at low temperatures.

One of the most suited superconductors for high-frequency is lead. It has a high transition temperature, it can be deposited easily and has a very low residual resistance.

For the measurement of the surface conductance Q-measurements of lead-coated resonators of the type TE_{111} were performed. At 9.4 GHZ a Q_o of 8.84×10^6 at 4.2°K and of 2.23×10^8 at 1.95°K was measured. Details of the preparation and the measuring techniques are given. The problem of low-loss superconducting joints which are crossed by surface currents and its solution is discussed.

The special applications of superconducting resonators are due to their extreme high Q which causes high voltage enhancement and a very narrow band-width. The most interesting application is the linear accelerator for charged particles since it promises a most effective energy transfer from the high frequency field to the beam. For the measurement of the superconducting accelerator sections a new measuring technique arises. Extreme stable microwave generators are needed. They can be made from an amplifier with a feedback via a superconducting transmission cavity. As another example field-electron emission in a superconducting cavity is described which is used for frequency multiplication of microwaves.

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