Contribution ID: **7** Type: **not specified**

A theory of field-dependent surface resistance and possibilities of engineering optimal SN and SIS surface nano-structuring of the SRF cavities

Monday, 8 October 2018 17:30 (25 minutes)

We propose a theory of the nonlinear surface resistance of a dirty superconductor in a strong RF field, taking into account realistic materials features, such as magnetic and nonmagnetic impurities, subgap states originating from finite quasiparticle lifetimes, and a proximity-coupled normal layer at the surface. The Usadel equations with the RF pair-breaking current are solved to obtain the quasiparticle density of states (DOS) and the low-frequency surface resistance Rs as functions of the RF field amplitude H0. It is shown that interplay of the broadening of the DOS peaks and a decrease of a quasiparticle gap caused by the RF field produce a minimum in Rs(H0) and an extended rise of the quality factor Q(H0) with the RF field. Paramagnetic impurities shift the minimum in Rs(H0) to lower fields and can reduce Rs(H0) in a wide range of H0. Subgap states can give rise to a residual surface resistance while reducing Rs at higher temperatures. A proximity-coupled normal layer at the surface shifts the minimum in Rs(H0) to lower fields and can reduce Rs below that of the perfect surface without the normal layer. The theory shows that the behavior of Rs(H0) can change as the temperature and the RF frequency are increased. Our results explain why the field dependence of Q(H0) can be very sensitive to the materials processing and suggest that the surface resistance can be minimized by engineering optimum impurity concentration or properties of the surface normal layer. Applications of the theory to the SIS structures and multilayer coatings of the SRF cavities are discussed.

Primary author: Dr KUBO, Takayuki (KEK and ODU)

Co-author: Prof. GUREVICH, Alex (ODU)

Presenter: Dr KUBO, Takayuki (KEK and ODU)

Session Classification: Theoretical modelling of RF behaviour

Track Classification: Theoretical modelling of RF behavior