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Transition Edge Sensors for Quench Localization in SRF Cavity Tests

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The upcoming generation of accelerators demands for the design and installation of Superconducting Radiofrequency (SRF) cavities of different sizes and geometries. Many of these SRF cavities are based on bulk Nb in a He-II bath. The individual testing of these devices is necessary to identify eventual surface defects that could induce a quench during operation. A versatile way of adapting these tests to different cavities is non-contact thermometry. Making use of the second sound propagation in He-II, a hot spot on the cavity can be localized by trilateration. Metallurgic inspection can be performed on the identified area to investigate the limited performance of the material. So far, non-contact thermometry has been mainly based on Oscillating Superleak Transducers, an oscillating membrane detector sensitive to changes in the normal to superfluid component ratio in He-II. To improve the method, better space resolution and a more purely thermometric information of the second sound wave could be beneficial. This is the reason why Transitions Edge Sensors (TES) are being developed. TES are based on the superconducting (SC) transition of a thin film in the He-II temperature range. TES sense the huge electrical resistivity change of the film as a function of temperature for a given current density in a very narrow temperature range. In this work, a TES fabrication method has been conceived using state-of-the-art photolithography techniques obtaining sensors of less than 1 mm2 typical size. Different choices of materials (substrate and thin film composition) and sensor geometry have been characterized in the SC transition, verifying the capability of these sensors to detect with good signal-to-noise ratio a second sound event. Subsequently, a robust camera-like device with a network of many sensors at different positions has been created in order to provide a compact element that allows trilateration of quench hotspots.

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