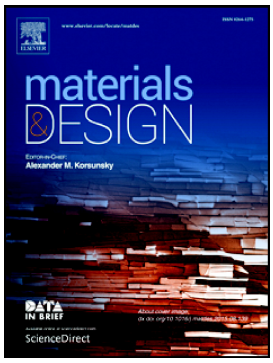

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Thin film analysis of transition edge sensors for use in next-generation superconducting radio frequency cavities

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Abstract

In order to increase the accelerating gradient, the next-generation of Superconducting Radio Frequency (SRF) cavities will be operated with superfluid helium cooling. This upgrade requires the development of a state-of-the-art cryogenic temperature mapping system, which can be used to identify quench initiation in new cavities, and thereby assess their suitability for installation. This paper presents a new mapping system based on an array of Transition Edge Sensors (TESs): electrical devices that exploit the superconducting transition of a thin film to identify temperature changes.

The TES array is manufactured using photolithography to deposit a thin film on a 100 mm diameter glass wafer. Two different designs of Au-Sn TES have been assessed; Design 1 was composed of a 10 nm Cr adhesive layer, followed by 20 nm of Au and 100 nm of Sn, and Design 2 was identical except that the Cr layer was not applied.

Design 1 showed excellent film adherence, however no superconducting transition was observed. In contrast, Design 2 showed poor film bonding but a superconducting transition. These insights are being used to design a new cryogenic temperature mapping device that combines Design 1 for robust electrical contacts and Design 2 for second sound detection.

Keywords

Transition edge sensor

Cryogenic temperature mapping

Thin films

Scanning electron microscopy

Superconducting radio frequency cavities

Large Hadron Collider