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Preliminary development of near-feild radiative heat transfer measurement system for high-temperature superconductor

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With the miniaturisation and high efficiency of electronic devices, near-field (NF) radiation has become a key factor in the study of thermal radiation control in electronic devices. NF radiative heat transfer (RHT) is several orders of magnitude greater than far-field (FF) radiation in the vacuum state, while it has been found that NF radiation decreases significantly as the sample passes from the normal state to the superconducting state. To investigate the mechanism of superconducting transitions on thermal radiation modulation, we have designed a cryogenic device to study NF radiation from high-temperature superconducting materials in different states (superconducting or normal state). The samples consist of concentric discs, and the spacing is controlled and measured using a nanoscale displacement device with adjustable spacing ranging from 10-1000 μm. Capacitance sensors are positioned at each of the four corners of the emitter and absorber to measure parallelism between the two samples with an accuracy of up to nanometer level. This device utilises a thermopile heat flow meter to transfer heat to the liquid nitrogen bath. The required measurement accuracy is 0.1 μV/W/m2.

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