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Current filamentation in large $Bi_2Sr_2CaCu_2O_8$ mesas observed by luminescent and scanning laser thermal microscopy[1] TIMOTHY BENSEMAN, YANG HAO, ALEX KOSHELEV, VITALII VLASKO-VLASOV, ULRICH WELP, WAI-KWONG KWOK, Materials Science Division, Argonne National Laboratory, BORIS GROSS, MATTHIAS LANGE, DIETER KOELLE, REINHOLD KLEINER, University of Tuebingen, Germany, KAZUO KADOWAKI, University of Tsukuba, Japan — Self-heating is a critical issue in stacked intrinsic Josephson junction devices designed for terahertz emission. Some theoretical models, as well as experimental evidence, suggest that self-heating may indeed be helpful for maximizing THz power output. Here we study the self-heating of a $Bi_2Sr_2CaCu_2O_8$ mesa terahertz source via two techniques. We show that low-temperature scanning-laser microscopy measurements - a sensitive, but indirect probe of device temperature - agree well with direct temperature measurements obtained via a thermo-luminescent imaging technique. Due to the semiconductor-like c-axis resistivity of $Bi_2Sr_2CaCu_2O_8$, we find that at low temperatures device self-heating is highly non-uniform, displaying hysteretic nucleation of narrow hotspots with elevated current density. Also, the hotspot radius grows with increasing device temperature. These behaviors are consistent with theoretical predictions for a current filament forming in a material whose resistance falls with increasing temperature.

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