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Voltage scale for electro-thermal runaway[1] Y.Y. LAU, U of Michigan, Ann Arbor, MI, USA, D. CHERNIN, SAIC, McLean, VA, USA, PENG ZHANG, R.M. GILGENBACH, ADAM STEINER, U of Michigan, Ann Arbor, MI, USA — Contact problems account for 40% of all electrical/electronic failures [1]. Current crowding leads to intense local heating in both bulk [2] and thin film contacts [3], and is a concern to high power microwave sources, pulsed power systems, field emitters, thin film devices, and interconnects, etc. We investigate electro-thermal instability (ET) due to the increase in electrical conductivity as temperature increases, which may lead to thermal runaway at fixed voltage. We deduce a voltage scale for ET onset [4], $V_s = \sqrt{\kappa/\sigma_0'}$ [in volts], where κ is the thermal conductivity [in W/(m-K)] and σ_0' is the rate of change of the electrical conductivity with respect to temperature [in 1/(ohm-m-K)]. V_s depends only on material properties and is independent of geometry or the operating voltage. It measures the intrinsic tolerance of the material to ET. The calculated V_s are consistent with the well-known properties of several common materials, such as Si, Ge, C (graphite), and SiC [4].

[1] *Review of Federal Programs for Wire System Safety*, NSTC Final Report, 2000. [2] Zhang, PhD dissertation, UM, Ann Arbor (2012). [3] Zhang et al., IEEE TED 59, 1936 (2012); J. Phys. D: Appl. Phys. 46, 065502 (2013); ibid 46, 209501 (2013); IEEE JEDS (in the press, 2013). [4] Lau, et. al., PPPS Proc 2013.

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Peng Zhang
U of Michigan, Ann Arbor, MI, USA

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