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The temperature dependent gap edge in strong-coupling superconductors DAVID G. WALMSLEY, XUEHENG ZHENG, Queen's University Belfast — Using the theory of Eliashberg and Nambu for strong coupling superconductors we have calculated the gap function for a model superconductor and a selection of real superconductors including the elements Al, Sn, Tl, Nb, In, Pb, and Hg and one alloy, Bi_2Tl. We have determined the temperature dependent gap edge in each and found that in materials with weak electron-phonon coupling ($\lambda < 0.8$)it is single-valued but in materials with intermediate coupling ($0.8 \leq \lambda \leq 1.2$) the gap edge is double-valued whereas in materials with strong coupling ($\lambda > 1.20$) not only is the gap edge double-valued but it also departs significantly from the BCS form and develops a shoulder-like structure which may in some cases denote a gap edge exceeding the $T = 0$ value. These computational results support the insights obtained by Leavens in an analytic consideration of the general problem. Both the shoulder and double value arise from a common origin seated in the form of the gap function in strongly coupled materials at finite temperatures. From the calculated gap function we can determine the densities of states in the materials and the form of the tunneling current-voltage characteristics for junctions with these materials as electrodes. By way of illustration results are shown for the contrasting cases of Sn ($\lambda = 0.74$) and Hg ($\lambda = 1.63$). The reported results are distinct in several ways from BCS predictions.

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