Comment on "Microscopic Theory for Dilute Quadrupole Glasses"

Klein [1] offers measurements by Dobbs, Foote, and Anderson [2] of the specific heat of KBr containing 320 ppm KCN as support for his theory of elastic quadrupole interactions. Our systematic investigations of $(KBr)_{1-x}(KCN)_x$, for $0 \leq x \leq 1.0$ [3,4], do not support this theory: We have found that the shape of the tunneling-state specific-heat anomaly remains unchanged in the CN^- concentration range from 30 to 850 ppm (see Fig. 7 of Ref. [3]), and that its magnitude scales with the concentration, as shown in Fig. 1. We have concluded that the broadening of the Schottky anomaly in this concentration range is caused by random internal stresses which are independent of CN^- concentration. Evidence for interactions appears only at higher concentrations; see Fig. 1 (also Fig. 4 of Ref. [4]). However, the specific heat near 0.1 K never shows any sign of an increase with the square of the concentration, as predicted by Klein's theory. Rather, the specific heat for a 0.8% sample is somewhat smaller than expected for a linear concentration dependence, and at 1.0%, the specific heat actually decreases with increasing concentration, as it approaches the specific heat characteristic for glasses (see Fig. 1). Similarly, a semblance of a glasslike thermal conductivity does not appear until the KCN concentration reaches 5% (Figs. 3 and 4 of Ref. [3]), far outside the concentration range considered by Klein.

This work has been supported in part by the U.S. National Science Foundation, Grant No. DMR-87-14-788.

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Received 26 December 1990
PACS numbers: 61.42.+h, 63.20.Mt, 65.40.Hq

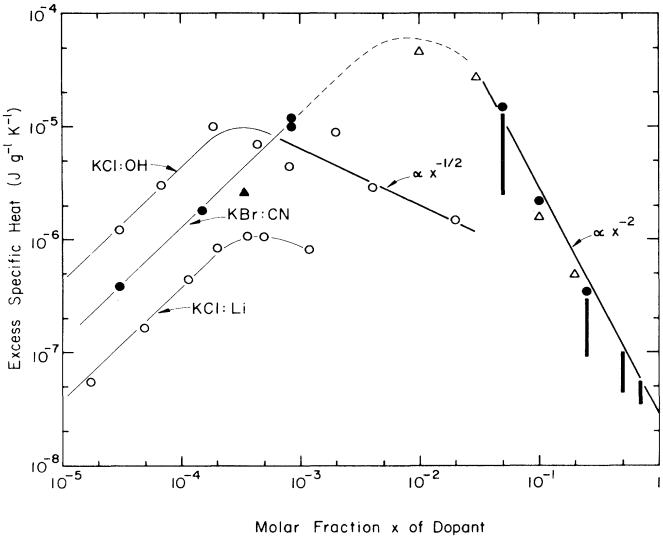

FIG. 1. Measured specific heat minus Debye specific heat at 0.1 K. All data points are taken after 10–100 s internal equilibration times (for references see the caption in Fig. 17 of Ref. [3]). For $x \geq 0.05$, the vertical bars indicate time-dependent specific heat measured between 1 ms (low end of bar) and 10 s (upper end). The straight lines through the data in the low-x range, $x < 10^{-4}$, indicate a scaling of the specific-heat anomaly with x, i.e., the absence of defect-defect interactions. These begin to show up at $x \sim 3 \times 10^{-4}$ for OH^- and Li^+, but for CN^- only above 10^{-3}. The dashed curve connecting the high-x and the low-x data for $(KBr)_{1-x}(KCN)_x$ is drawn to visualize where CN^--CN^- interactions may be expected to set in at 0.1 K. The solid line through the OH^- data above $x = 10^{-3}$ varies as $x^{-1/2}$, as first suggested by Fiory. The solid line labeled x^{-2} is an empirical relation observed in this investigation (Ref. [3]).

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