

Retraction: Bulk superconductivity and fully gapped superconducting state in Ba-doped phenanthrene [Phys. Rev. B **85**, 214520 (2012)]

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After the paper was published, the Ba-doped phenanthrene sample, which was provided by Professor X. H. Chen from the University of Science and Technology of China (as acknowledged in our paper) and which showed a superconducting transition temperature T_c of 4.9 K as derived from magnetization measurements, was investigated further by high-resolution diffraction measurements using synchrotron x-ray radiation. Figure 1(a) shows the comparison of the x-ray diffraction (XRD) patterns [(I) from Fig. 1 of our paper (laboratory XRD data) and (II) synchrotron data] of the “Ba-doped phenanthrene” sample with those of (III) hexagonal-closed-packed (hcp) elemental La and (IV) pristine phenanthrene. The simulated pattern of hcp elemental La [space group $P6_3/mmc$, $a = 3.77$ and $c = 12.159$ Å (Ref. 1)] and the XRD profiles of the present sample are very similar to each other as shown in Fig. 1(b), which displays the expanded Q region of the data between 1.7 and 4.0 Å⁻¹. This similarity

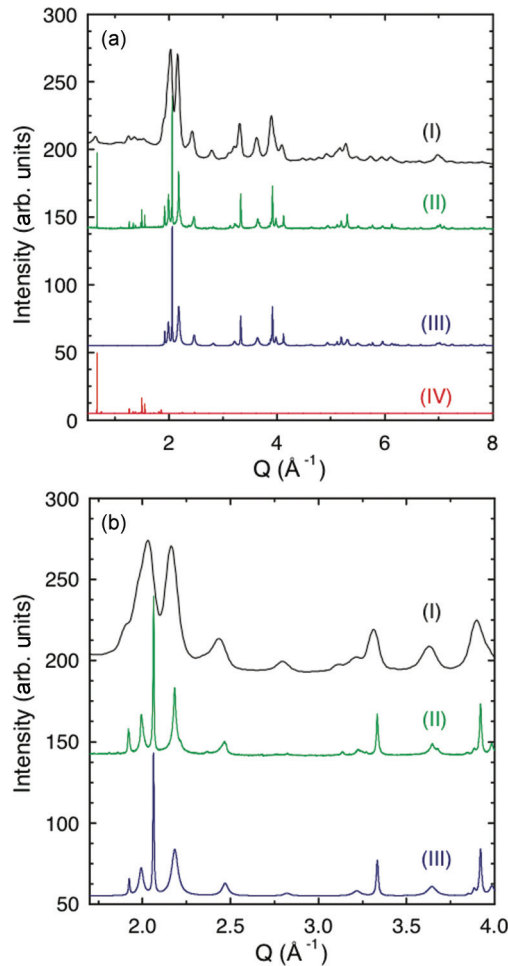


FIG. 1. (Color online) Comparison of measured and simulated x-ray diffraction profiles showing (a) (I) the data collected on a laboratory diffractometer using a Mo- K_α source (same as in Fig. 1 of our paper), (II) high-resolution synchrotron diffraction pattern of the same sample, collected on beamline ID31, European Synchrotron Radiation Facility (ESRF), Grenoble ($\lambda = 0.399\,837$ Å), (III) a simulated pattern calculated for hcp lanthanum [space group $P6_3/mmc$, $a = 3.77$ and $c = 12.159$ Å (Ref. 2)] with a March-preferred orientation and anisotropic peak broadening applied in the (0 0 4) direction (March coefficient = 0.9), and (IV) a simulated pattern calculated for phenanthrene ($P2_1$, $a = 8.462$, $b = 6.164$, $c = 9.479$ Å, and $\beta = 98.07^\circ$) with a March-preferred orientation in the (2 0 0) and (0 0 1) directions (March coefficients 0.35 and 0.58, respectively). (b) Zoom of the highest intensity peaks showing the clear similarities between the high-resolution pattern and that of hcp lanthanum.

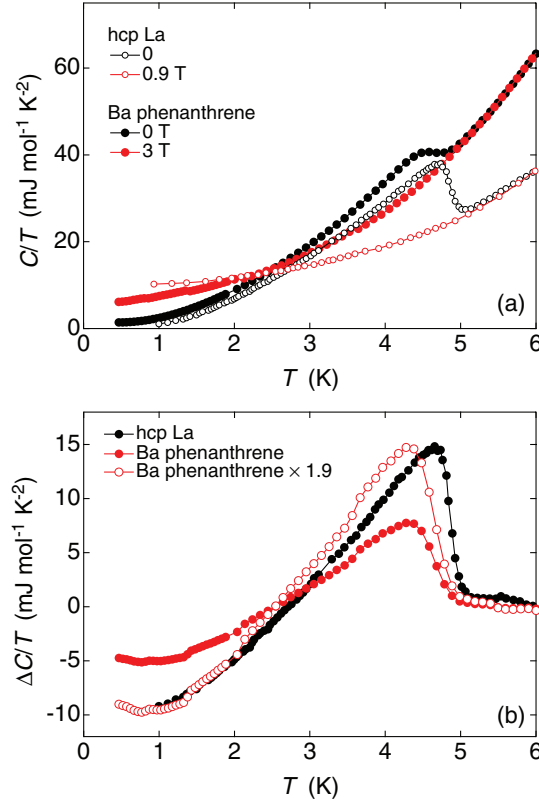


FIG. 2. (Color online) Temperature dependence of (a) the specific heat C/T and (b) the electronic specific heat $\Delta C/T = C/T(0\text{ T}) - C/T(H > H_{c2})$, where H_{c2} is the upper critical field for the present sample and for hcp lanthanum.³ Here, for the present sample, the atomic weight of elemental La is used rather than the molecular weight of Ba-doped phenanthrene.

indicates that both sets of data [(I) and (II)] are completely dominated by the Bragg reflections of the hcp polymorph of the elemental La metal, which is known to be a superconductor with $T_c = 4.9\text{ K}$.²

Based on this knowledge, we have reanalyzed the specific heat data in our paper. Figures 2(a) and 2(b) show the temperature dependence of the specific heat (C/T) and the electronic part of the specific heat [$\Delta C/T = C/T(0\text{ T}) - C/T(H > H_{c2})$, where H_{c2} is the upper critical field], respectively, in the Ba-doped phenanthrene sample. For comparison, we show C/T and $\Delta C/T$ in hcp elemental La, taken from Ref. 3. The absolute value of C/T in Ba-doped phenanthrene was corrected by using the atomic weight of the La metal rather than the molecular weight of the Ba-doped phenanthrene. Here, we assumed that Ba was replaced with the La metal and that superconductivity arises only from the La metal. As shown in Fig. 2(b), the reported $\Delta C/T$ for Ba-doped phenanthrene shows a similar temperature dependence to that for elemental La when a factor of 1.9 is multiplied. This striking similarity also supports the fact that the present sample contains a significant amount of elemental La in the hcp form.

Both sets of data (Figs. 1 and 2) indicate that the sample used in our paper contains a large amount of a hcp polymorph of the elemental La metal, and thus, the specific heat anomaly with $T_c = 4.9\text{ K}$ is dominated by the La metal rather than by a putative Ba-doped phenanthrene superconductor.

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¹F. H. Spedding, A. H. Daane, and K. W. Herrmann, *Acta Crystallogr.* **9**, 559 (1956).

²See, for instance, K. Schwidtal, *Z. Phys.* **169**, 564 (1962).

³D. L. Johnson and D. K. Finnemore, *Phys. Rev.* **158**, 376 (1967).