Comment on "Emergence of a Superconducting State from an Antiferromagnetic Phase in Single Crystals of the Heavy Fermion Compound Ce_2PdIn_8"

A recently published Letter [1] has reported on the antiferromagnetism (AF) and ambient-pressure superconductivity (SC) in a Ce_2PdIn_8 single crystal with $T_N \sim 10$ K and $T_c = 0.68$ K, respectively. Although we very much appreciate the effort exerted to prepare and characterize this new heavy fermion (HF) superconductor (SC), we would like to add a cautionary note that the reported Néel temperature coincides remarkably with $T_N = 10.2$ K of $CeIn_3$ [2]. It therefore leads us to consider the possible presence of $CeIn_3$ in the samples that were investigated. In other $Ce_nTIn_{3n+2}(n = 1, 2)$ compounds [3–5] the AF is either absent (T = Co, Ir) or remarkably limited to much lower temperatures (T = Rh). These compounds form a quasi-two-dimensional tetragonal structure with the $CeIn_3$ and TIn_2 layers alternating along the (001) direction. Hence one might expect that the AF correlations develop within the $CeIn_3$ layers while the interaction between the layers will be weaker as reported for $CeRhIn_5$, an incommensurate AF ($T_N = 3.8$ K) [6]. The remarkable agreement of the T_N values in the reported Ce_2PdIn_8 with the well-known $CeIn_3$ is not discussed in the Letter [1]. Neither the striking discrepancy between their own results on single crystals [1] and polycrystals (reported paramagnetic down to 0.35 K [7]) has been explained. The absence of SC in the polycrystalline sample is explained by an unconventional coupling sensitive to structural disorder, internal strains, and/or tiny changes in the composition, but the disagreement in the magnetic ground state is not discussed at all.

Although a detailed phase analysis (x-ray diffraction and microprobe) of the crystals was claimed to have been done [1], we would, however, still like to suggest that a $CeIn_3$ single crystal covered by a single-crystalline layer of Ce_2PdIn_8 was in fact that which was investigated. From the reported heat capacity data, we estimate the amount of $CeIn_3$ to be 15%–20%. In such case, a microprobe analysis of the sample's surface would not be able to detect it. Also, most of the diffraction peaks of both compounds interfere, because they have an almost equal lattice parameter $a = 0.4693$ nm [8] and $a = 0.4689$ nm [9] for Ce_2PdIn_8 and $CeIn_3$, respectively.

Our first magnetization data obtained on crystals grown analogously to [1] were in agreement with the Letter. A careful microprobe analysis, however, indicated a presence of $CeIn_3$, and element mapping showed that Ce_2PdIn_8 and $CeIn_3$ form a sandwichlike system with well-defined regions (see Fig. 1).

To confirm that the AF originates in $CeIn_3$, we have measured more than 5 different $CeIn_3$-free samples of Ce_2PdIn_8 by means of resistivity, heat capacity, and magnetic susceptibility; paramagnetic behavior with significant magnetocrystalline anisotropy was observed down to a SC temperature [10].

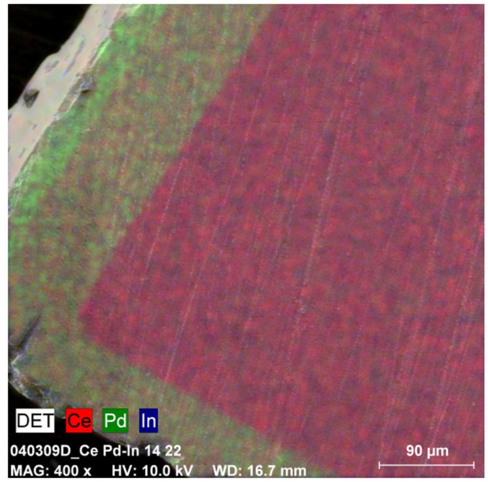

FIG. 1 (color online). EDX element mapping of a typical polished sample. $CeIn_3$ (central region) is covered by a layer of Ce_2PdIn_8 (frame) and $Ce_{1.5}Pd_{1.5}In_7$ (thin stripe on the left).

The SC with $T_c = 0.7$–0.45 K (sample dependent) has been confirmed in our samples. The difference of critical temperature is probably given by structural planar defects, which were also observed in Ce_2RhIn_8 [11]. In agreement with [1], the SC has a HF character and it is a bulk property of the compound but it does not emerge out of a long-range AF state below the Néel temperature of 10 K because the reported AF was due to presence of an impurity phase.

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[1] D. Kaczorowski *et al.*, Phys. Rev. Lett. **103**, 027003 (2009).
[2] J. M. Lawrence *et al.*, Phys. Rev. B **22**, 4379 (1980).
[3] G. F. Chen *et al.*, J. Phys. Soc. Jpn. **71**, 2836 (2002).
[4] J. S. Kim *et al.*, Phys. Rev. B **69**, 024402 (2004).
[5] R. Movshovich *et al.*, Phys. Rev. Lett. **86**, 5152 (2001).
[6] W. Bao *et al.*, Phys. Rev. B **62**, R14 621 (2000).
[7] D. Kaczorowski *et al.*, Physica (Amsterdam) **404B**, 2975 (2009).
[8] D. V. Shtepa *et al.*, Mosc. Univ. Chem. Bull. **63**, 162 (2008).
[9] I. R. Harris *et al.*, J. Less-Common Met. **9**, 7 (1965).
[10] K. Uhlířová *et al.*, Intermetallics (to be published).
[11] E. G. Moshopoulou *et al.*, Acta Crystallogr. Sect. B **62**, 173 (2006).

