Critical Behavior of Quasi Two-Dimensional Ferromagnet $Fe_{1/4}TaS_2$

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Abstract

The critical behavior of single-crystalline layered quasi two-dimensional ferromagnet $Fe_{1/4}TaS_2$[1-3] were studied by magnetization around the paramagnetic to ferromagnetic phase transition region. Critical exponents β=0.46 and γ=1.2 are extracted from the Kouvel-Fisher plot[4], whereas δ=3.69 is obtained by the critical isotherm analysis at T_C=100.7K. These critical exponents obey the Widom scaling relation $\delta=1+\gamma/\beta$.[5] Moreover, the self-consistency and reliability of the results are further verified by scaling equations. The determined exponents match well with those calculated from the results of renormalization group approach, and our analysis suggests that $Fe_{1/4}TaS_2$ possesses three-dimensional long-range magnetic interaction with the exchange distance decaying as $J(r) \approx r^{-4.8}$.

References

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Figures

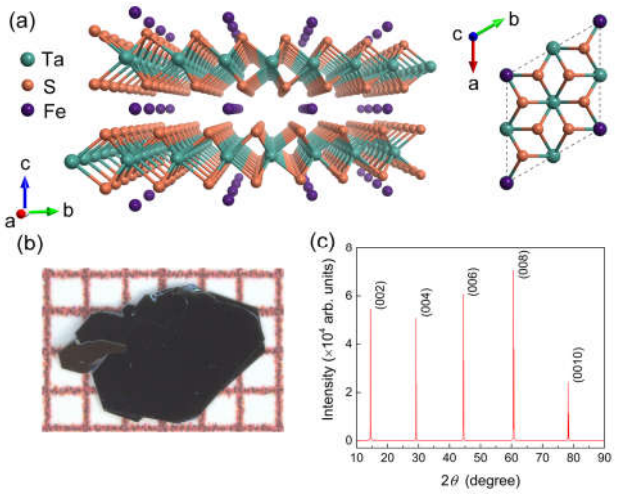

Figure 1: (a) The crystal structure, (b) optical image and (c) XRD pattern of $Fe_{1/4}TaS_2$.

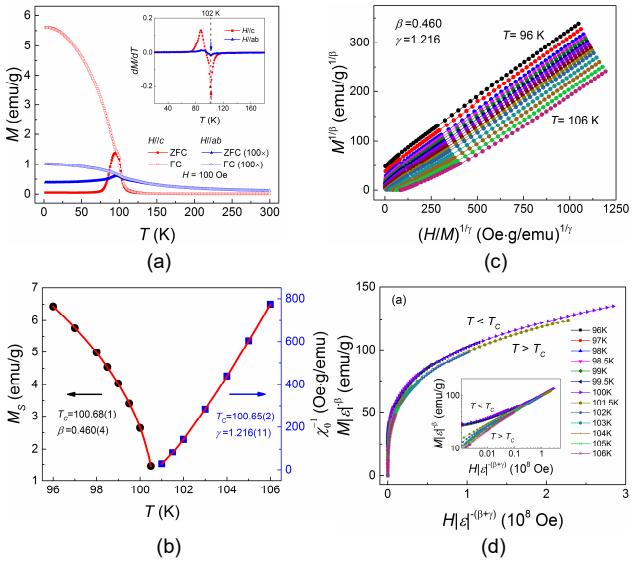

Figure 2: (a)Temperature and field dependent magnetization data of $Fe_{1/4}TaS_2$; (b)critical exponents obtained by critical analysis; (c) Modified Arrott plot; (d) Scaling equation of state in critical asymptotic region. The curves are obviously separated into two branches, which ensure that the obtained critical exponents and T_C are reliable and accordant with the scaling hypothesis.