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Spin reorientation and 'quasi-nematic' order in the re-entrant tetragonal phase of $Ba_{0.76}K_{0.24}Fe_2As_2$ CHANG-WOO CHO, JIANQIANG HOU, JUNYING SHEN, POK MAN TAM, I-HSUAN KAO, MANG HEI GORDON LEE, Department of Physics, The Hong Kong University of Science and Technology, THOMAS WOLF, CHRISTOPH MEINGAST, Institute for Solid State Physics, Karlsruhe Institute of Technology, ROLF LORTZ, Department of Physics, The Hong Kong University of Science and Technology — Clarifying the phase diagram and the nature of the competing or coexisting orders between magnetism, nematicity and superconductivity is of primary importance for the understanding of the mechanism of iron-based superconductors. Here, we investigate the re-entrant tetragonal phase in $Ba_{0.76}K_{0.24}Fe_2As_2$ in detail by DC magnetisation, resistivity, thermal expansion, thermal conductivity and thermo-electrical measurements. The thermal expansion indicates that the transition into the re-entrant phase is incomplete, but becomes more complete in high magnetic fields. The magnetization provides strong evidence that the spin alignment in the re-entrant C_4 phase is out-of-plane. The Nernst coefficient shows a large negative value in the stripe-type spin density wave (SDW) state owing to the Fermi surface reconstruction associated with nematic order. At the transition into the re-entrant C_4 tetragonal phase it hardly changes, suggesting that a similar quasi-nematic electronic order could be present in this phase, in a novel form that preserves the tetragonal crystal symmetry. We propose a chequerboard type of charge or orbital ordering that replaces the nematic order of the stripe-type SDW phase below the C_4 re-entrant transition.

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