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**Atomic scale visualization of novel magnetic phase transitions in Fe-based superconductor $Sr_4V_2O_6Fe_2As_2$** SEOKHWAN CHOI, Dept. of physics, KAIST, WON-JUN JANG, CAPP, IBS, JONG MOK OK, Dept. of physics, POSTECH, HYUN WOO CHOI, HYUN JUNG LEE, JIN OH JUNG, DONG HYUN SON, Dept. of physics, KAIST, HWAN SOO SUH, SAIT, JUN SUNG KIM, Dept. of physics, POSTECH, YANNIS K. SEMERTZIDIS, CAPP, IBS, JHIN-HWAN LEE, Dept. of physics, KAIST — $Sr_4V_2O_6Fe_2As_2$ consists of superconducting FeAs layers and Mott insulating $Sr_2VO_3$ layers, and exhibits superconductivity with $T_c$ near 30 K despite being a parent compound material. Unlike normal Fe-based superconductors, the magnetism of $Sr_4V_2O_6Fe_2As_2$ has complexity due to the presence of two magnetic atomic layers of V and Fe; therefore, the issue of magnetism has been actively debated. In this work, we studied the orbital and magnetic phase transitions in the range of 4 K to 180 K using spin-polarized scanning tunneling microscope. We directly observed the changes of charge density waves of V atomic layer related to the nematicity at 150 K, and spin density waves of V atomic layer resulting from spin ordering of underlying Fe atomic layer below 50 K. Moreover, controlling the sample bias voltage, the hysteresis of magnetic domain is observed at 4 K. Our results show key clues to solve controversy about the magnetism of $Sr_4V_2O_6Fe_2As_2$.

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