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Quasi-Two-Dimensional Metallic Ground State of $Ca_3Ru_2O_7$

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$Ca_3Ru_2O_7$ is a three-dimensional antiferromagnetic metal between a first-order metal to nonmetal transition at 48 K and the antiferromagnetic ordering temperature, T_N=56 K[1]. The crystal structure is the double layered Ruddlesden-Popper type with the $Bb2_1m$ space group, which has both the rotation and tiling of RuO_6 octahedra. We have succeeded in growing single crystals of $Ca_3Ru_2O_7$ using a floating-zone method for the first time. The temperature dependence of the electrical resistivity establishes that $Ca_3Ru_2O_7$ develops a quasi-two-dimensional metallic ground state below 30 K, from which the observed quantum oscillation derives. The specific heat measurement reveals the electronic specific-heat coefficient γ to be as small as 1.7 mJ/Ru mol K^2[2]. From the results of powder neutron diffractions, we proposed the most possible magnetic structure with an antiferromagnetic ordering. The field dependence of the resistivity at the metamagnetic transition around 6 T can be explained by the tunneling magnetoresistance. This work was done in collaboration with S. I. Ikeda, N. Shirakawa, C. H. Lee, M. Kosaka, and S. Katano. [1] G. Cao et al., Phys. Rev. Lett. 78 (1997) 1751. [2] Y. Yoshida et al., Phys. Rev. B 69 (2004) R220411.