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Magnetic Structure of $EuFe_2As_2$ Determined by Resonant X-ray and Neutron Scattering Experiments

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The iron arsenide superconductors have attracted much attention recently because of appearance of high T_c superconductivity and possibility of exotic paring mechanism. Among them, undoped $EuFe_2As_2$ is specially interesting in that it has two different kinds of magnetic elements. Eu- and Fe-magnetic structures in $EuFe_2As_2$, however, are not yet thoroughly studied with the scattering techniques due to small Fe moment and high absorption of neutrons by Eu. Here, by applying neutron and resonant X-ray scattering in Eu L_2 edge, we have determined Eu and Fe magnetic structures and temperature dependences of both staggered magnetizations. These measurements have revealed that Fe spins are antiferromagnetically ordered below 188K while Eu spins do below 19 K. Iron magnetic structure is consistent with other compounds in this series, which implies that Fe sublattice moments are not strongly coupled with Eu moments. The weak coupling seems to originate from the fact that planes of Eu and Fe are well separated. We have also found that structural phase transition occurs at the same temperature with the transition temperature of Fe antiferromagnetism. Together with critical exponents of structural and Fe magnetic order parameters, this strongly suggests that coupling exists between them in the form of a linear-quadratic term in the framework of Ginzburg-Landau description.

Keywords : $EuFe_2As_2$, resonant x-ray scattering, neutron scattering