^{57}Fe and ^{151}Eu Mössbauer studies of 3d-4f spin interplay in $EuFe_{2-x}Ni_xAs_2$

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Mössbauer spectroscopy is a useful local probe for investigation of the iron-based superconductors [1] and their parent compounds. The $EuFe_{2-x}Ni_xAs_2$ compounds exhibiting 3d and/or 4f magnetic order were investigated by means of ^{57}Fe and ^{151}Eu Mössbauer spectroscopy [2]. Additionally, results for the end members of this system, i.e. $EuFe_2As_2$ and $EuNi_2As_2$, are reported for comparison. It was found that spin-density-wave order of the Fe itinerant moments is monotonically suppressed by Ni-substitution. However, the 3d magnetic order survives at the lowest temperature up to at least x = 0.12 and it is certainly completely suppressed for x = 0.20. The Eu localized moments order regardless of the Ni concentration, but undergo a spin reorientation with increasing x from the alignment parallel to the a-axis in the parent compound, toward c-axis alignment for x > 0.07. The change of the 4f spins ordering from antiferromagnetic to ferromagnetic takes place simultaneously with a disappearance of the 3d spins order what is the evidence of a strong coupling between magnetism of Eu^{2+} ions and the conduction electrons of $[Fe_{2-x}Ni_xAs_2]^{2-}$ layers. The Fe nuclei experience the transferred hyperfine magnetic field due to the Eu^{2+} ordering for Ni-substituted samples with x > 0.04, while the transferred field is undetectable in $EuFe_2As_2$ and for compound with a low Ni-substitution level. It seems that the 4f ferromagnetic component arising from a tilt of the Eu^{2+} moments to the crystallographic c-axis leads to the transferred magnetic field at the Fe atoms.

References:

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