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Photomagnetic complexes. Structures of excited states

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Photoinduced magnetization is an interesting property in materials, with special focus on the development of new memory devices. We have synthesized a range of complexes with the general formula $M1(DMF)_4(H_2O)_3(m-CN)M2(CN)_5 \cdot H_2O$ ($M1M2DMF$), where M1 is a rare earth metal and M2 a transition metal. For NdFeDMF it has been shown that the material has a significant photoinduced magnetization. Upon UV irradiation the material stays in the excited state for several hours. The mechanism causing this large change in the magnetic susceptibility is not yet understood, and in order to understand the nature of the electronic transition it is crucial to know exactly which electrons are involved in the process. For that reason electron density studies are of great importance. The long lived metastable state makes it possible not only to study electron densities in the ground state but also in the excited state as well without the need for time resolution. As a first step towards excited state electron densities we have measured the structure in the excited state of NdFeDMF as well as four other complexes, which show the same behavior upon UV-illumination.

Keywords: photomagnetic complexes, excited state structures, lanthanide atoms

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Absolute intensity and phase of the resonant X-ray scattering from a germanium crystal

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For understanding of the physics of resonant scattering, it is essential to measure not only the magnitude but also the phase of the scattering amplitude, both of them are strongly changed with energy. In contrast to the purely resonant 600 reflection in Ge crystal, 222 reflection is weakly allowed even in the non-resonance region. Thus the energy spectrum of the 222 reflection is caused by the interference of the weak non-resonant and purely resonant contributions to the tensor atomic factor. The 222 reflection near the germanium K absorption edge was studied on

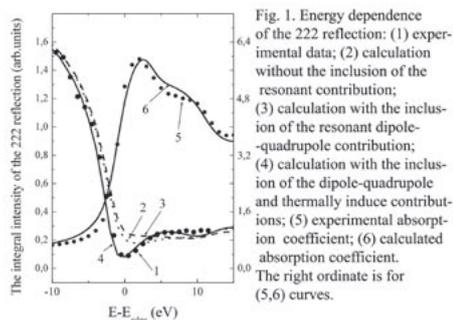


Fig. 1. Energy dependence of the 222 reflection: (1) experimental data; (2) calculation without the inclusion of the resonant contribution; (3) calculation with the inclusion of the resonant dipole-quadrupole contribution; (4) calculation with the inclusion of the dipole-quadrupole and thermally induced contributions; (5) experimental absorption coefficient; (6) calculated absorption coefficient. The right ordinate is for (5,6) curves.

the Kurchatov synchrotron radiation source (fig.1). The spectral dependence of the absolute intensity and phase of the resonant X-ray scattering from a Ge crystal was determined from the interference of the resonant and non-resonant contributions to the 222 reflection. The numerical simulation of the energy spectra of reflection with the inclusion of the temperature-independent dipole-quadrupole and thermally induced dipole-dipole contributions shows that the latter is dominant at room temperature. This work was supported by the Russian Foundation for Basic Research, project nos. 06-02-17249 and 07-02-00324.

Keywords: resonant scattering, synchrotron radiation, tensor atomic factor

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Quantitative evaluation of quadrupole transition effect in ATS scattering from magnetite, Fe_3O_4

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ATS (anisotropic tensor of the susceptibility) scattering can be observed in *forbidden* Bragg reflections near absorption edge with synchrotron radiation. Magnetite has a spinel structure, in which the Fe atoms occupy the tetrahedral A site and the octahedral B site. The ATS scattering with dipole-dipole (d-d) transition process is allowed for the B site but not allowed for the A site. For the A site, therefore, we must consider higher dipole-quadrupole (d-q) transition. We previously studied the energy and azimuthal angle dependence of the 002 and 006 forbidden reflections. In the energy spectrum we found a main resonant peak just above the Fe K-edge and a second peak in the pre-edge region. From the ratio of the two reflections intensities we concluded that the main peak was mainly caused by d-d scattering from the B site and the pre-edge peak by d-q scattering from the A site. However, we did not quantitatively estimate each contribution because the azimuth dependence is completely same for the both transitions. In the present work, in order to evaluate the quantitative contribution from the A and B sites, we measured detailed azimuth dependence of the 046 forbidden reflection at the two resonant energies. Furthermore we measured separately each energy spectrum of the d-d or d-q scattering by utilizing the X-ray polarization property. From least-squares analysis of the azimuth dependence, we evaluated absolute value of the anisotropic tensorial element for the d-d and d-q scattering factors, $f(dd)$ and $f(dq)$. We obtained the ratio of the ATS scattering factors $f(dd):f(dq) = 3:2$ at the main resonance, while $f(dd):f(dq) = 1:4$ at the pre-edge resonance. Thus we have found that the d-q scattering from the A site has unexpectedly large effect on the both resonance.

Keywords: X-ray resonant scattering, magnetite, quadrupole transition

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Twenty-four beam X-ray diffraction in a two-plate Fabry-Perot silicon crystal cavity

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