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Response to the Comment to "Features of the Local Structure of Rare-Earth Dodecaborides RB_{12} (R = Ho, Er, Tm, Yb, Lu)" (JETP Lett. 98, 165 (2013))

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We are grateful to the authors of the comment for useful information.

They performed additional studies confirming that the accuracy of our EXAFS analysis allows the detection of the displacement of a small fraction of rare-earth ions from the centers of truncated octahedra B_{24}. The authors of the comment assume that the absence of change in the local structure at the transition to the cage-glass phase is due to the formation of a nonequilibrium state in a sample owing to the absorption of X-rays from a synchrotron source. This assumption is reasonable in the case of a high intensity of X-rays or a short duration of the process under study. For this reason, it is necessary to discuss the conditions of our experiment.

The X-ray absorption spectroscopy is based on the absorption of photons with energies of 8–9 keV corresponding to the L_3 absorption edges of atoms under study. At photon energies below 100 keV, the main contribution to absorption comes from the photoelectric effect at which the photoionization of electrons from inner shells of absorbing atoms occurs with the formation of a vacancy on an inner level. The lifetime of such a vacancy is about 10^{-15} s. Therefore, the excited state of the atom relaxes rapidly [1, 2]. The probability of excitation depends on the intensity of X-ray radiation and the number of absorbing atoms. The intensity of the synchrotron radiation beam in our experiments on a sample was 10^9 photons per second per millimeter squared. The number of absorbing atoms in the cross section of the beam can be estimated as $\sim 3 \times 10^{16}$ atoms/mm^2.

Thus, even at complete absorption, the fraction of excited atoms does not exceed 10^{-7}, which cannot lead to an excited state of the entire system. At the same time, if excitation affected the process under investigation, the EXAFS analysis would give information on a certain nonequilibrium state of the system irrespective of the number of excited atoms. We studied vibrations of rare-earth atoms with respect to the rigid sublattice of boron atoms with the energy of vibrations of about 200 K, corresponding to a phonon frequency of about 4×10^{12} Hz. Thus, the period of the vibrations under study is two orders of magnitude larger than the excitation lifetime of the atom absorbing an X-ray photon. As a result, the excitation of the atom can hardly affect these vibrations.

We believe that the EXAFS analysis cannot detect the transition to the cage-glass phase for another reason. The transition is accompanied by a change in the dynamics of vibrations of atoms in a double-well potential. However, the fraction of such atoms in the total number of atoms does not change. This fraction in the samples under study is only several percent. Its identification is at the limit of the accuracy of EXAFS experiments. The detection of changes in the dynamics of vibrations of such a small fraction of atoms is beyond the sensitivity of EXAFS spectroscopy.

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