FAR-INFRARED ABSORPTION DUE TO THERMALLY ACTIVATED RELAXATION IN VITREOUS SILICA

T. Ozaki, [1] H. Iriura,[1] S. Matsumoto,[1] T. Kosugi [2]

[1]*Department of Electronic and Photonic Systems Engineering, Faculty of Engineering, Hiroshima Institute of Technology, Hiroshima 731-5193, Japan*

[2]*Department of Environmental & Material Engineering, Faculty of Sci. & Eng., Teikyo University of Sci. & Tech., Yamanashi 409-0193, Japan*

Vitreous silica shows two low-energy excitations spectra in the region of 0.3-3 THz. One is the thermally activated relaxation mode below 1 THz due to the motion in double wells, while the other is the localized mode around 1 THz due to the harmonic motion in an intermediate range structure, what we call the boson peak. The present topic is the relation between both modes at zero wave number.

We have calculated the far-infrared absorption coefficient α of the thermally activated relaxation from the dielectric dispersion measured in the region of 10 Hz-1 kHz and 3-100 K [1]. The calculated α has been compared with the experimental α, which is recently measured at 11 K and 297 K in the region of 0.3-3 THz [2]. We represent the difference of α measured at 297 K and at 11 K by $\Delta\alpha_{\mathrm{m}}$ and the difference of α calculated at 297 K and at 11 K by $\Delta\alpha_{\mathrm{c}}$.

The value $\Delta\alpha_{\mathrm{c}}$ is equal to $\Delta\alpha_{\mathrm{m}}$ below 0.1 THz as well as above 1 THz. This shows that at 297 K the thermally activated relaxation is dominant below 0.1 THz and the localized mode, i.e. the boson peak, is dominant above 1 THz. Between 0.1 THz and 1 THz, in contrast, $\Delta\alpha_{\mathrm{c}}$ is smaller than $\Delta\alpha_{\mathrm{m}}$. This shows that $\Delta\alpha_{\mathrm{m}}$ is larger than the difference in the thermally activated relaxation between 297 K and 11 K. The difference of $\Delta\alpha_{\mathrm{m}}$ and $\Delta\alpha_{\mathrm{c}}$ forms a broad peak centered at 0.5 THz. The peak height is a half of $\Delta\alpha_{\mathrm{m}}$. These indicate two different origins.

(1) The broad peak centered at 0.5 THz is a novel low-energy excitation mode.

(2) The thermally activated relaxation mode around 0.14 THz and the localized mode around 1.2 THz strongly couple and enhance with each other at 297 K.

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[2] T. Ohsaka, T. Shoji and K. Tanaka: J. Phys. Soc. Jpn. **69** (2000) 3711.