Response to "Comment on 'Enhanced room-temperature emission in Cr 4 + ions containing alumino-silicate glasses' [Appl. Phys. Lett.87, 066103 (2005)]"

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Response to "Comment on 'Enhanced room-temperature emission in Cr^{4+} ions containing alumino-silicate glasses' [Appl. Phys. Lett. 87, 066103 (2005)]"

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We have examined the comments by Peng and co-authors[1] on our original paper referenced above.[2] In their comment the authors have attributed the room-temperature emission in a bismuth oxide doped lithium oxide–alumina–silica–zinc oxide (LASZ) glass due to the presence of Bi ions, although the ionic state of Bi ions contributing to 1300 nm emission has not yet been identified and characterized. Our main conclusions, based on their comments and our own findings are as follows.

(a) There appears to be a strong evidence for attributing the 1300 nm emission in the LASZ glass due to the presence of Bi ions. We have verified this by making samples without Cr ions and confirm most of the evidences presented in the comments submitted by Peng and co-authors.

(b) We, however, find that our results for pump excitation experiments differ significantly. In particular, the results presented in Fig. 2 in comments [cf. graph 2(c)] for the excitation experiment at wavelength, λ_{ex} =808 nm differ from those measured by us at 514 nm (Ar^+ ion) and 830 nm (Ti-sapphire), as can be seen in Fig. 1 in this letter. The composition of LASZ glass used for comparative purpose is same as those reported earlier in Ref. 2, and contains 49.1 mol % SiO_2, 25.5 mol % Al_2O_3, 17 mol % Li_2O, 5.7 mol % ZnO, 2.8 mol % Bi_2O_3, and 0.01 mol % Cr_2O_3. In Fig. 1 below we see the evidence for the emission peak at 1050 nm, with excitation wavelengths at near-IR (Ti-sapphire with 250 mW and InGaAs detector), which is clearly absent in Fig. 2(c) of the Comments submitted by Peng and co-workers. However, in Fig. 2(d) for LASZ samples with 0.01 mol % Cr_2O_3 and in Fig. 2(e) without Cr_2O_3 in the Comments, there is a clear evidence for a change in the intensity of emission peak centered at 1300 nm with 808 nm excitation source. In Fig. 2(f) with the 532 nm excitation source, the line shape changes significantly due to the apparent population inversion of different Bi ions.

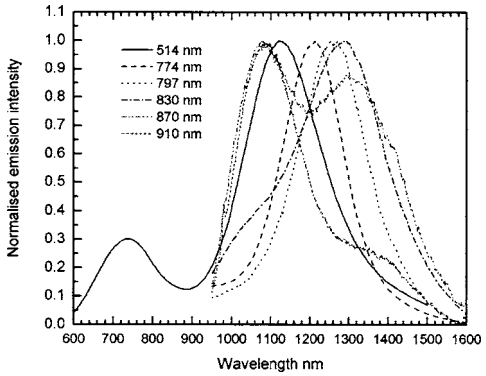

FIG. 1. A comparison of the emission spectra of glass in Ref. 1 at different excitation wavelengths at 514 nm and near IR in the 774–910 nm. The full width at half maximum is larger than 500 nm at 870 nm.

(c) From our results presented in Fig. 1 and 2 of the Comments, we confirm that there appears to be a complex cooperative energy transfer process among the different states of either Bi ions, or the Cr and Bi ions, which warrant further analysis. The evidence for energy transfer becomes more apparent from the complex exponential decay in these LASZ hosts, as reported in Fig. 3 in Ref. 1. The pump wavelengths longer than 797 nm source preferentially populate the $^3T_2$:Cr^{4+} level, as seen in our observations, and the consequent 1050 nm emission peak is the result of the $^3T_2 \rightarrow {}^3A_2$ transition from the Cr^{4+} ions at high-field sites. Since the $^3T_2$ level is quite broad,[3] we anticipate a favorable Stoke energy transfer from the Cr^{4+} site to Bi ions, which contribute to emission at around 1300 nm.

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