

# Sm<sup>3+</sup>/Gd<sup>3+</sup> co-doped lead/bismuth borogermanate glasses – new materials for luminescent thermometry

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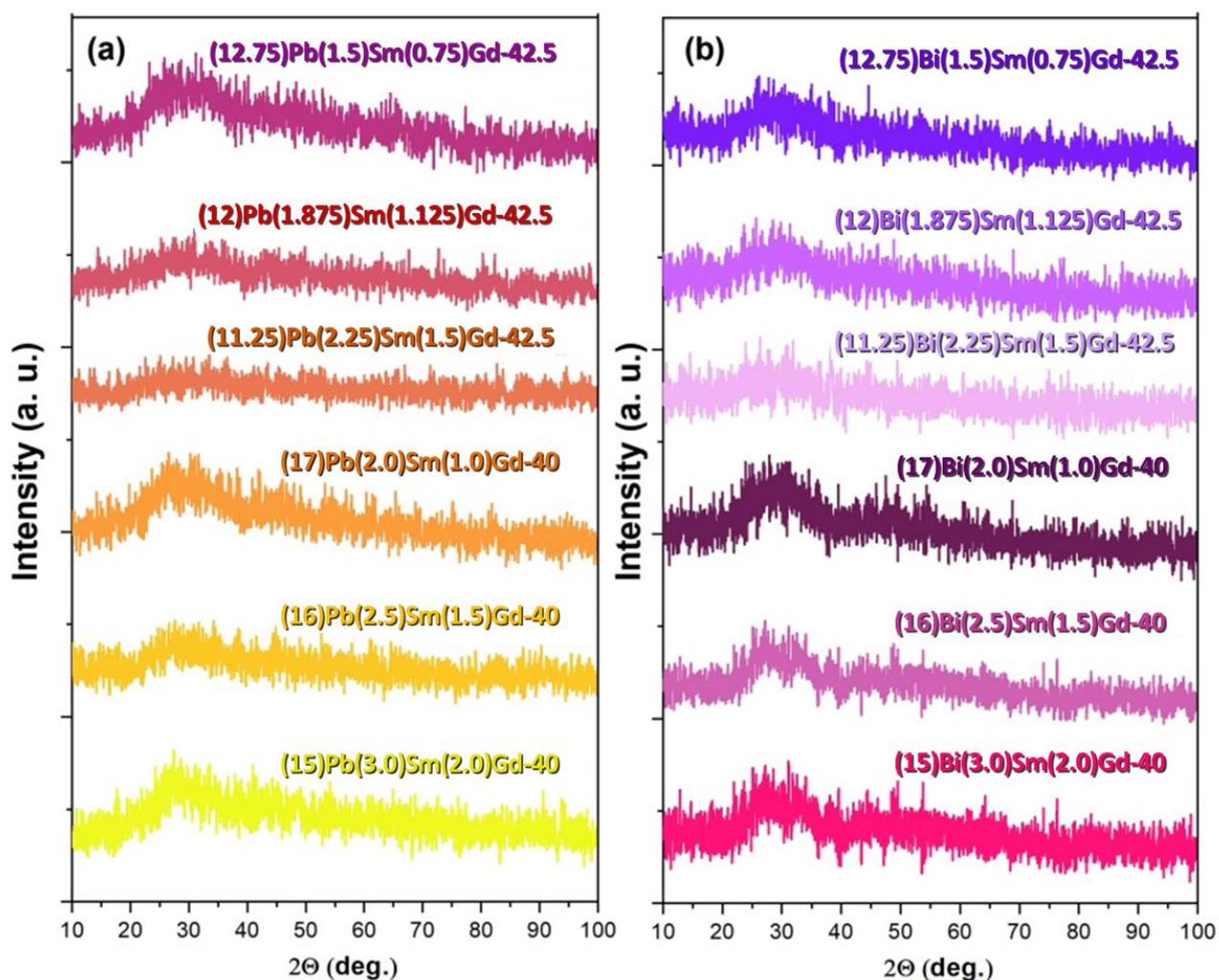


Figure S1. PXRD patterns of Pb-based (a) and Bi-based (b) glass samples.

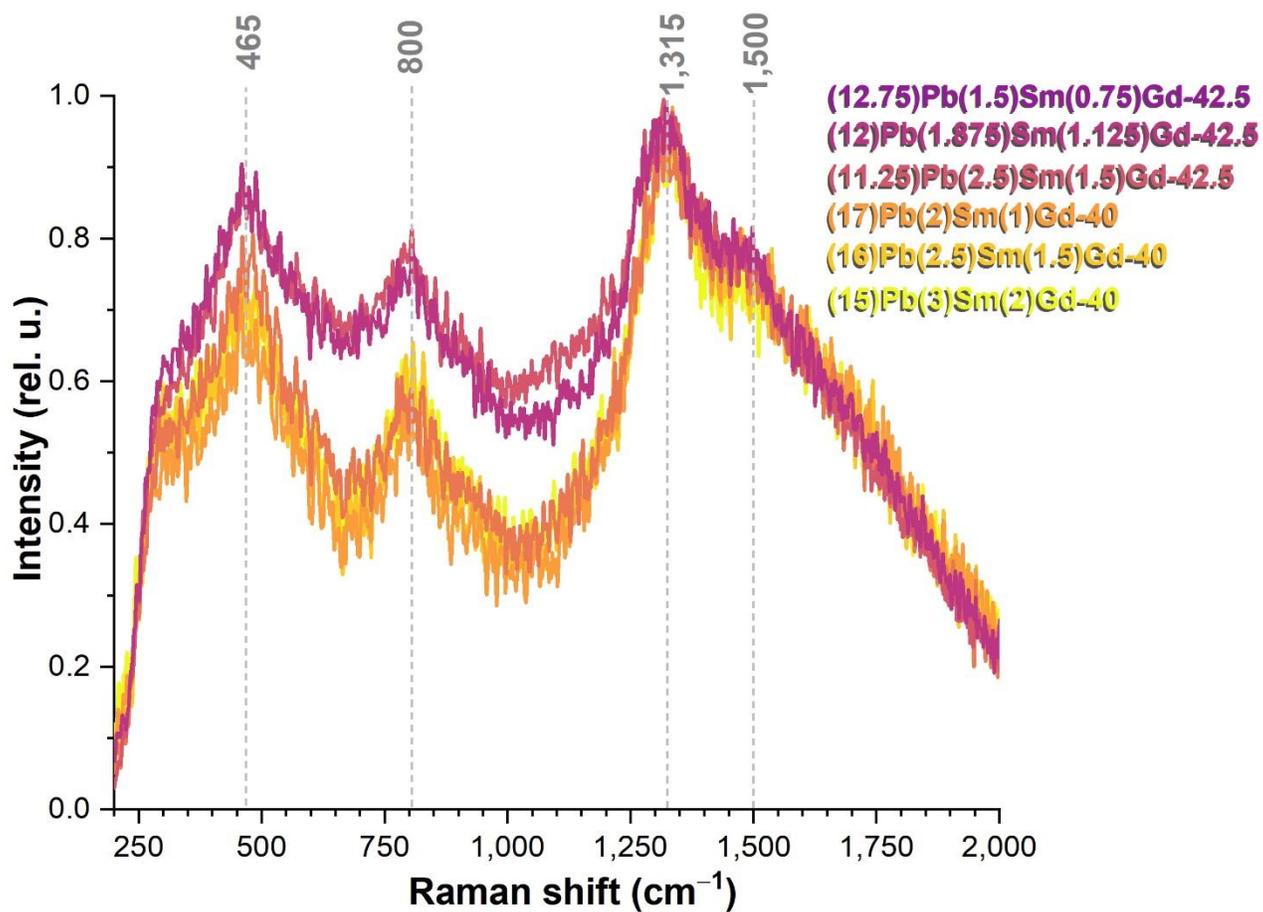


Figure S2. Raman spectra of Pb-based glass samples.

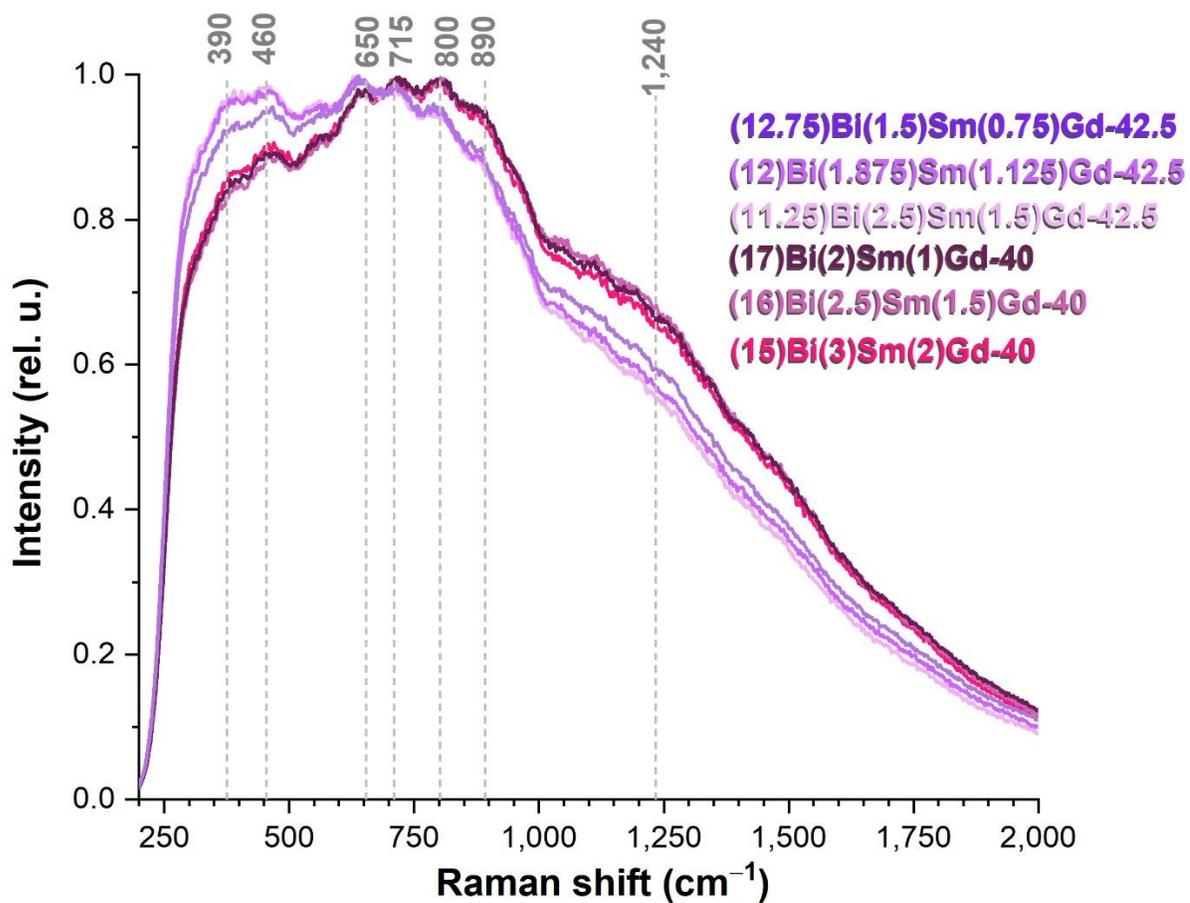


Figure S3. Raman spectra of Bi-based glass samples.

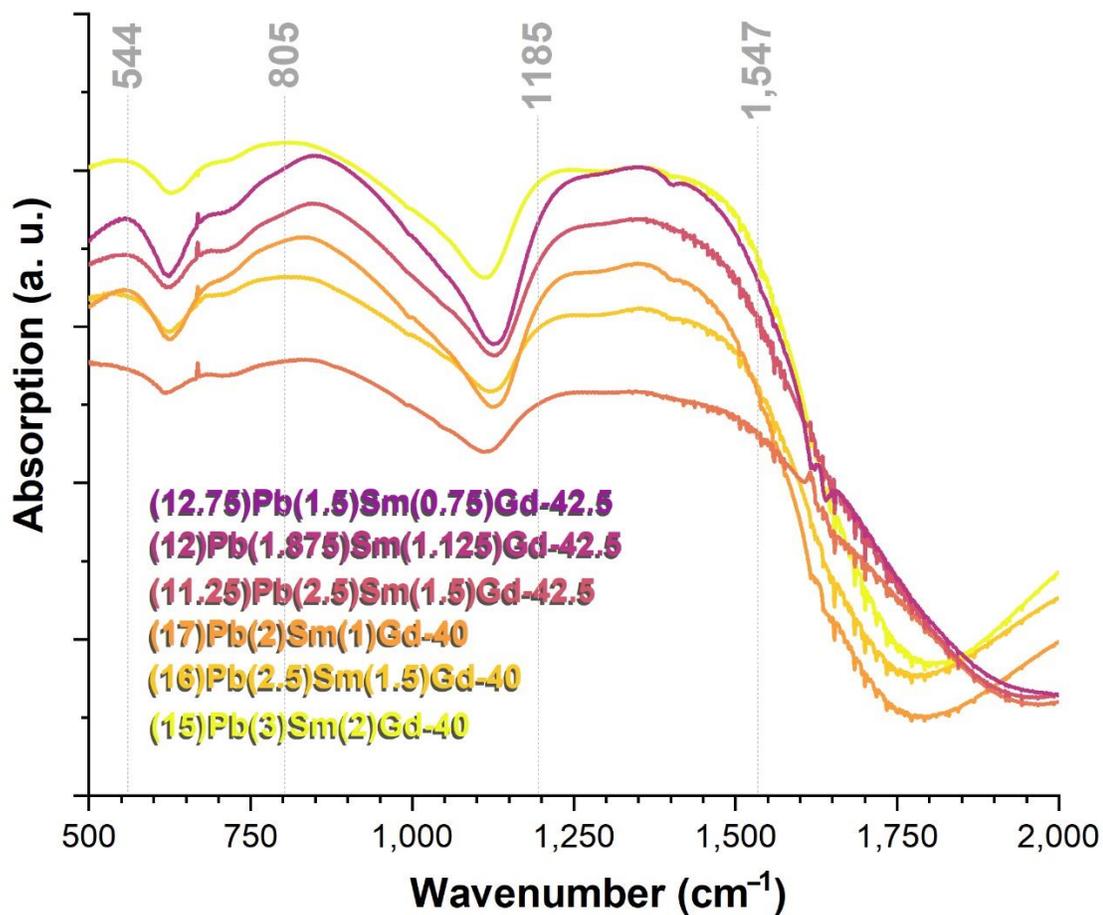


Figure S4. FT-IR spectra of Pb-based glass samples.

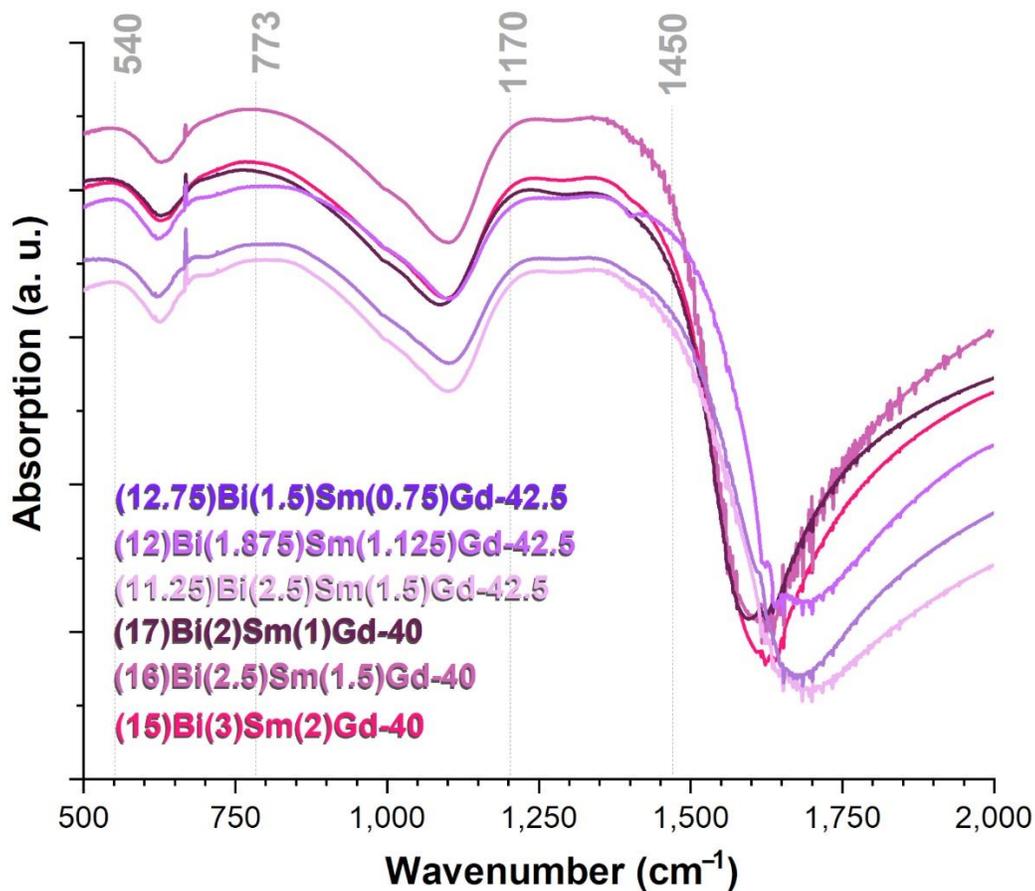


Figure S5. FT-IR spectra of Bi-based glass samples.

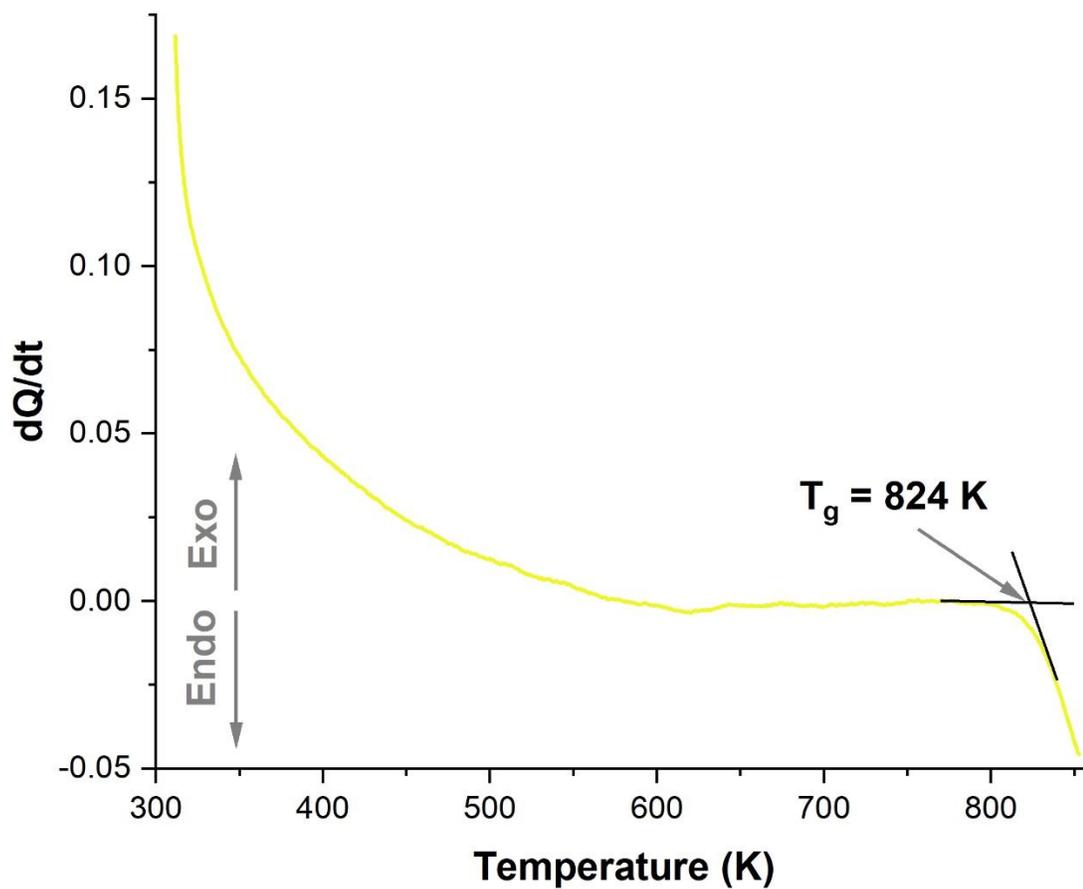


Figure S6. DSC curve for glass composition (15)Pb(3)Sm(2)Gd-40 and glass transition temperature.

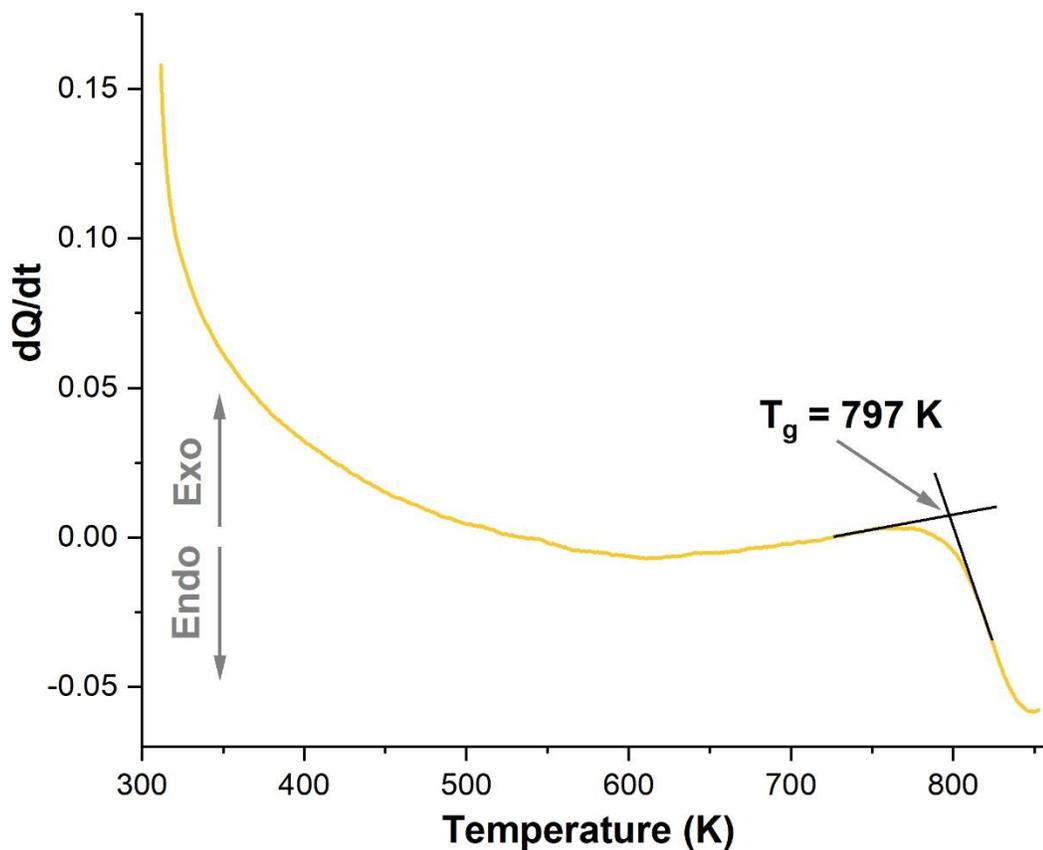
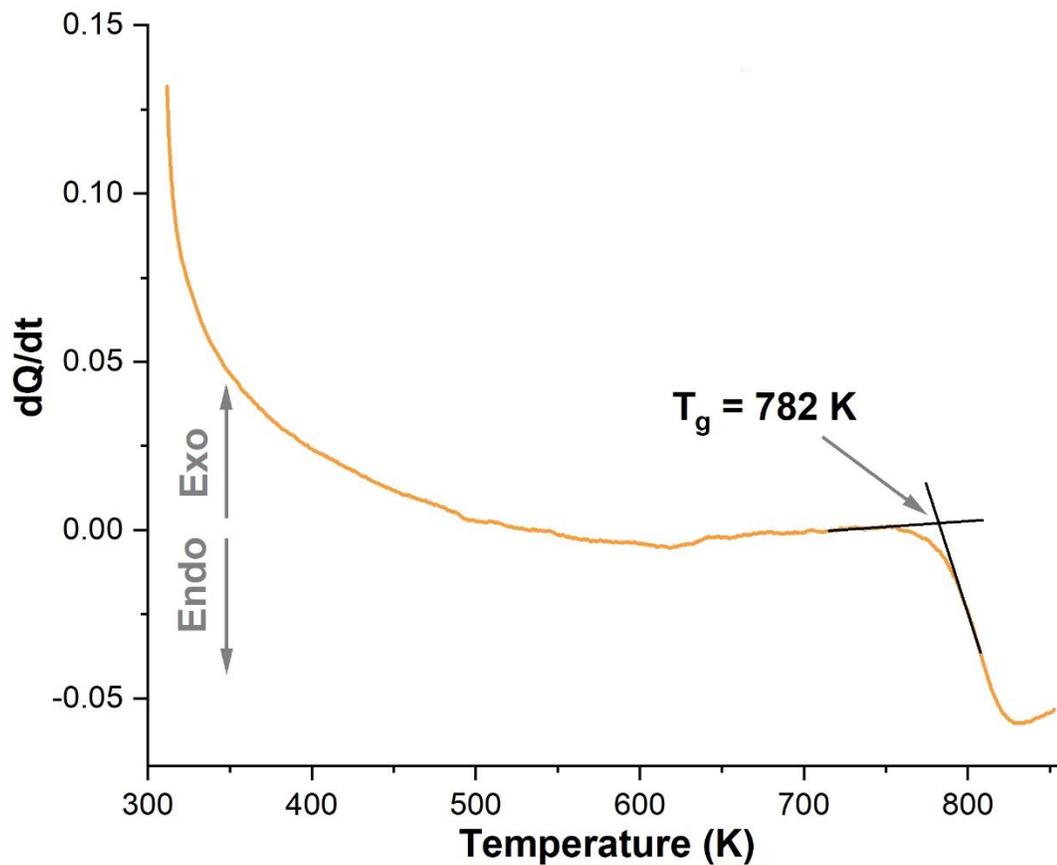
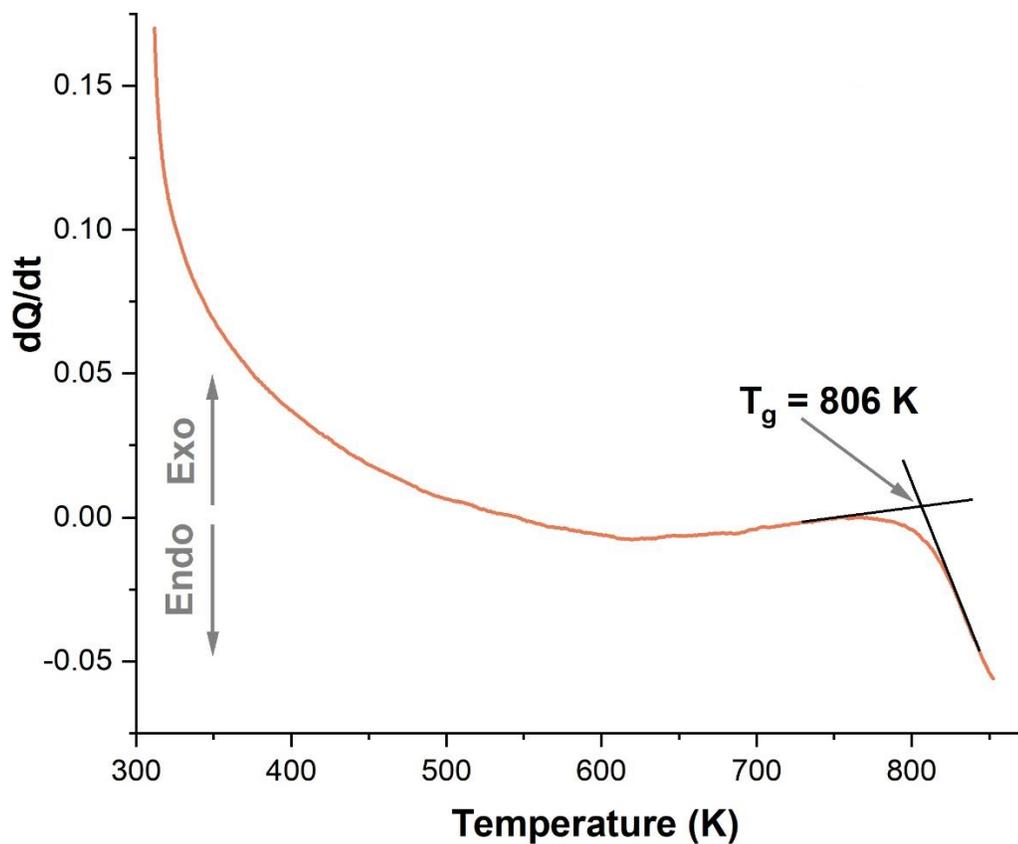


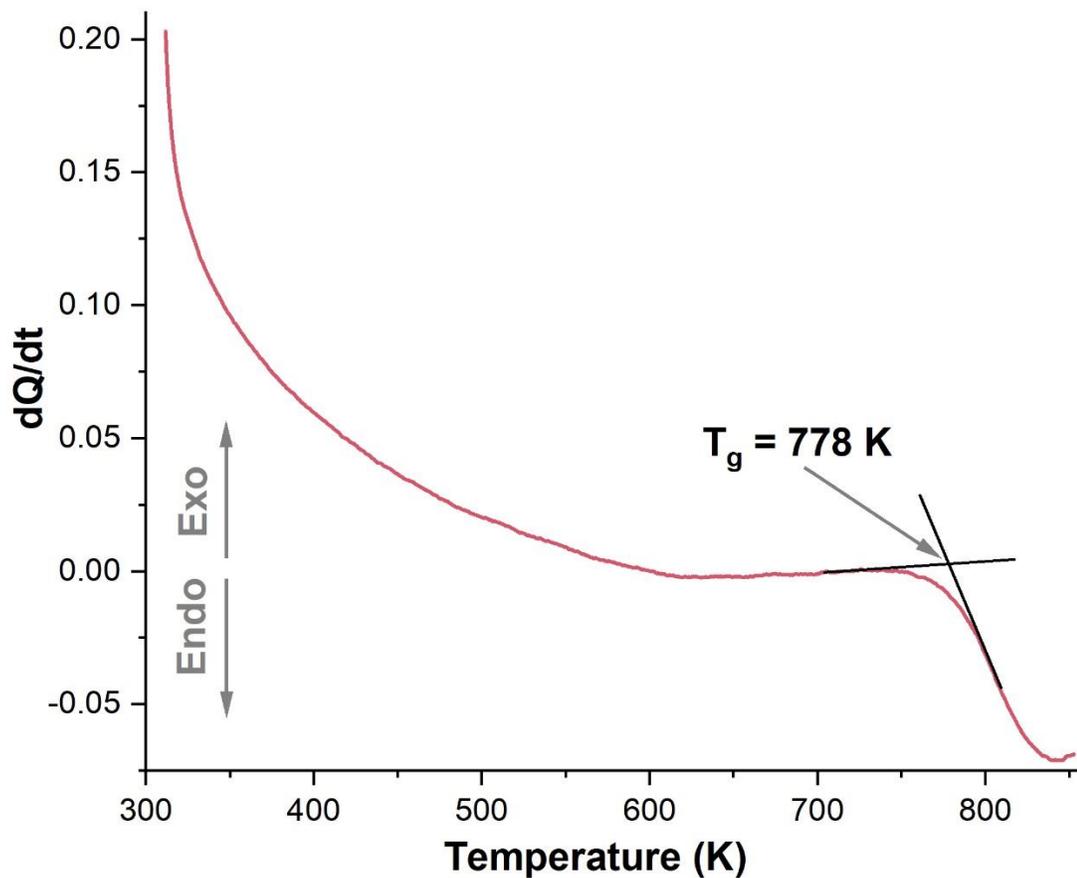
Figure S7. DSC curve for glass composition (16)Pb(2.5)Sm(1.5)Gd-40 and glass transition temperature.



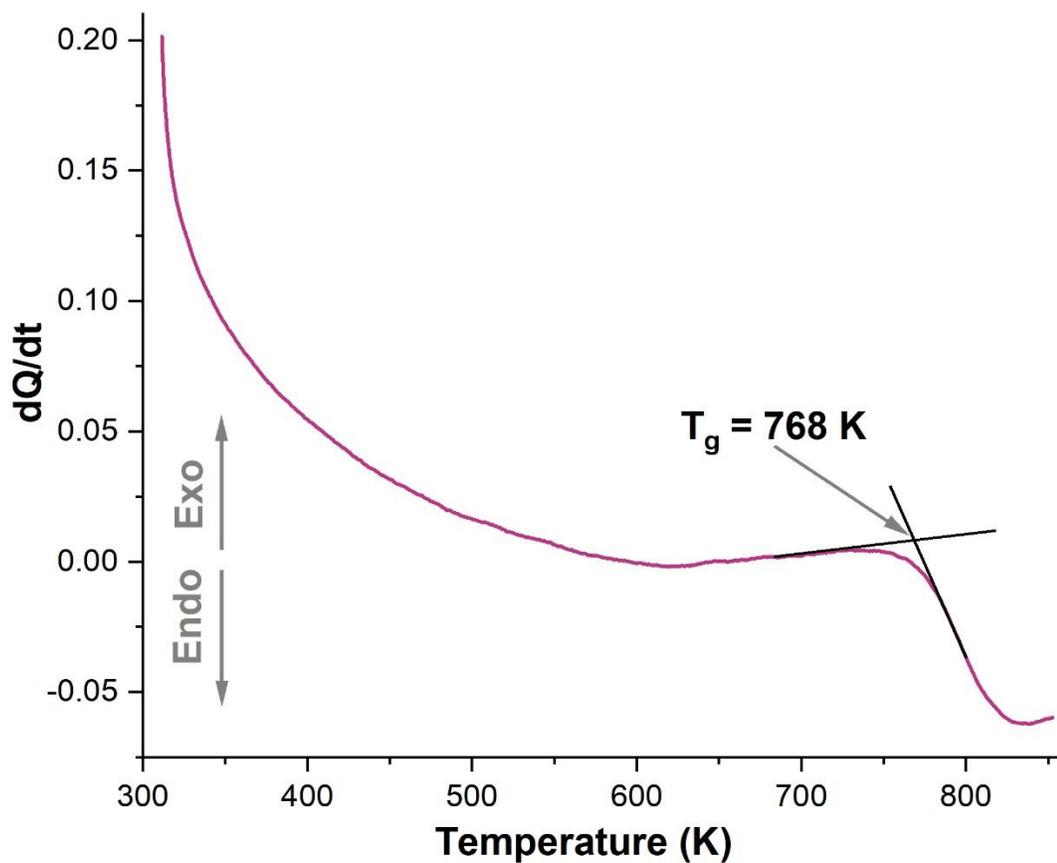
**Figure S8.** DSC curve for glass composition (17)Pb(2)Sm(1)Gd-40 and glass transition temperature.



**Figure S9.** DSC curve for glass composition (11.25)Pb(2.25)Sm(1.5)Gd-42.5 and glass transition temperature.



**Figure S10.** DSC curve for glass composition (12)Pb(1.875)Sm(1.125)Gd-42.5 and glass transition temperature.



**Figure S11.** DSC curve for glass composition (12.75)Pb(1.5)Sm(0.75)Gd-42.5 and glass transition temperature.

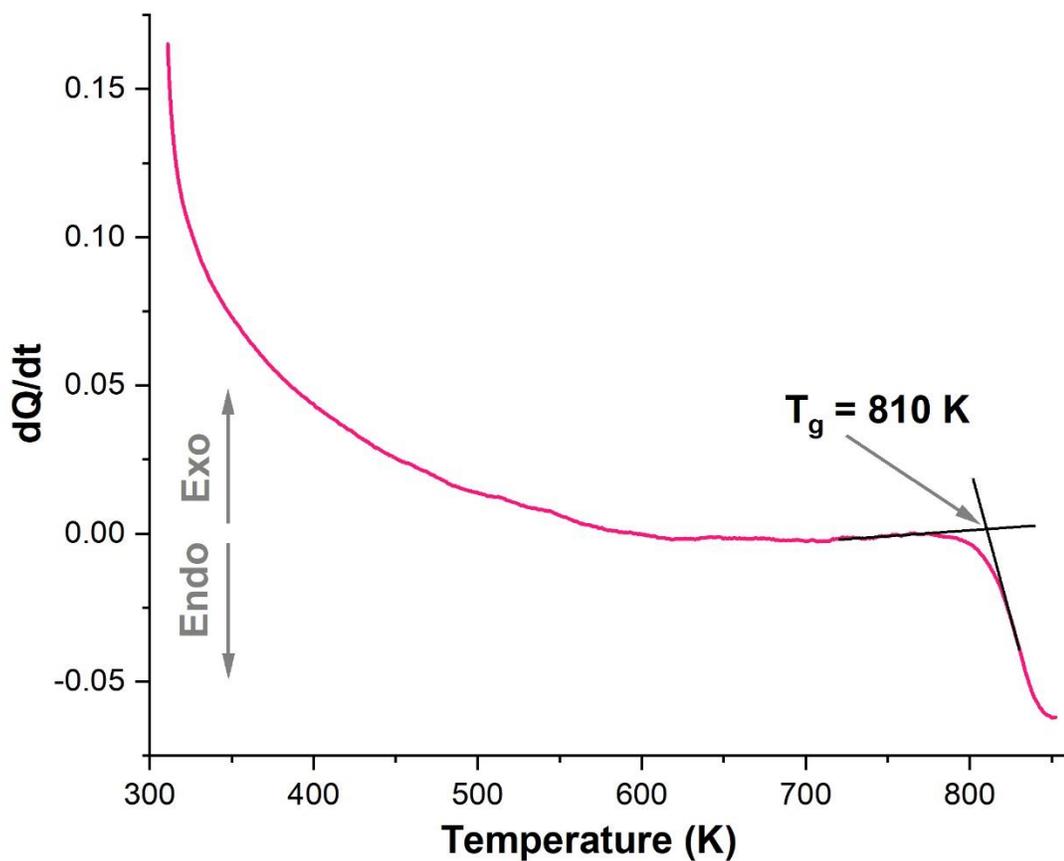


Figure S12. DSC curve for glass composition (15)Bi(3)Sm(2)Gd-40 and glass transition temperature.

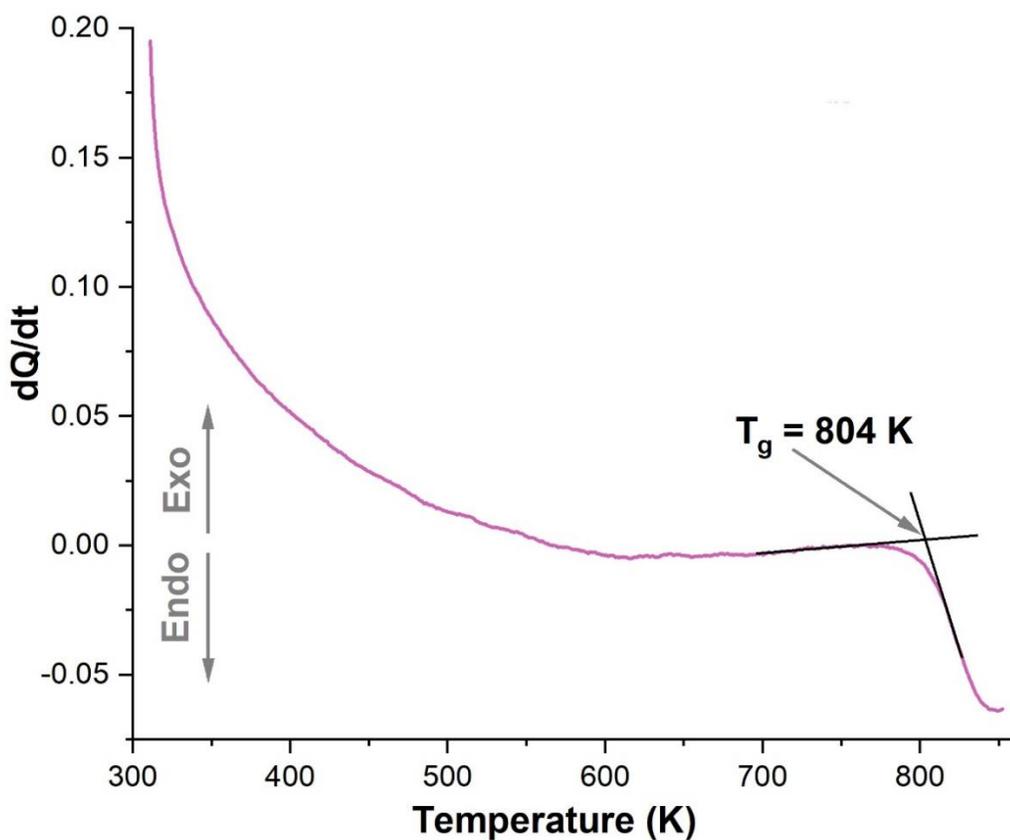


Figure S13. DSC curve for glass composition (16)Bi(2.5)Sm(1.5)Gd-40 and glass transition temperature.

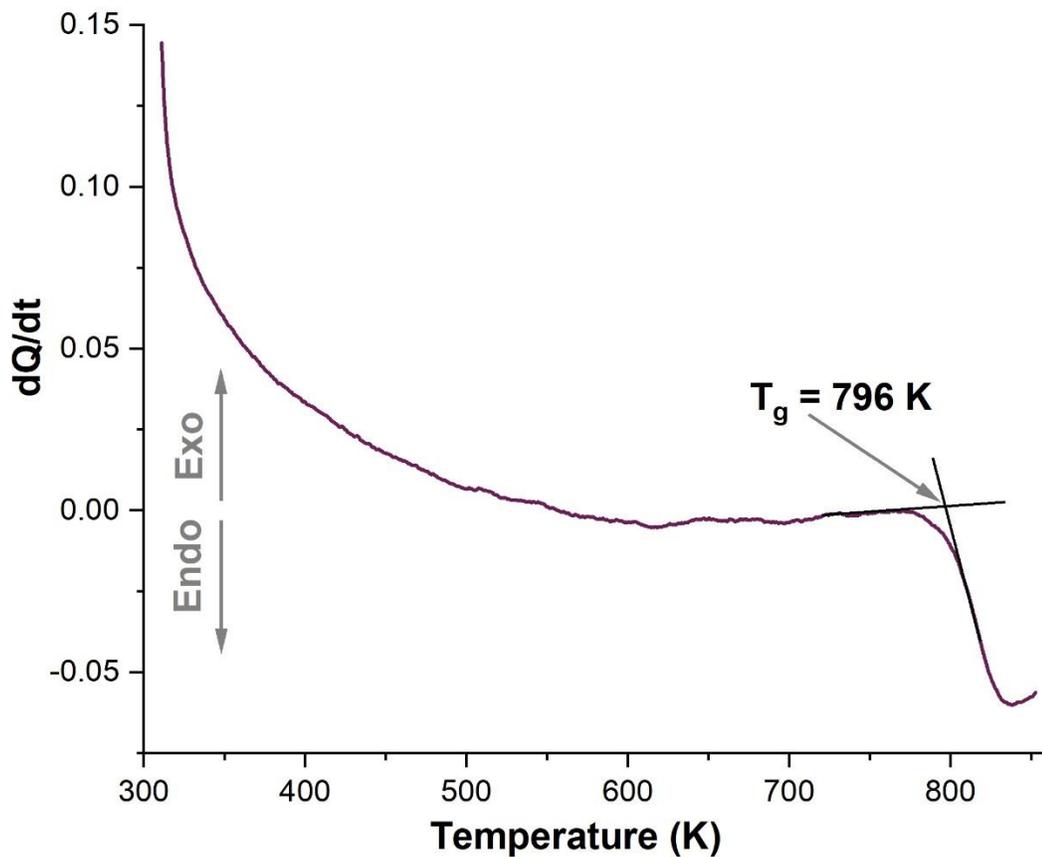


Figure S14. DSC curve for glass composition (17)Bi(2)Sm(1)Gd-40 and glass transition temperature.

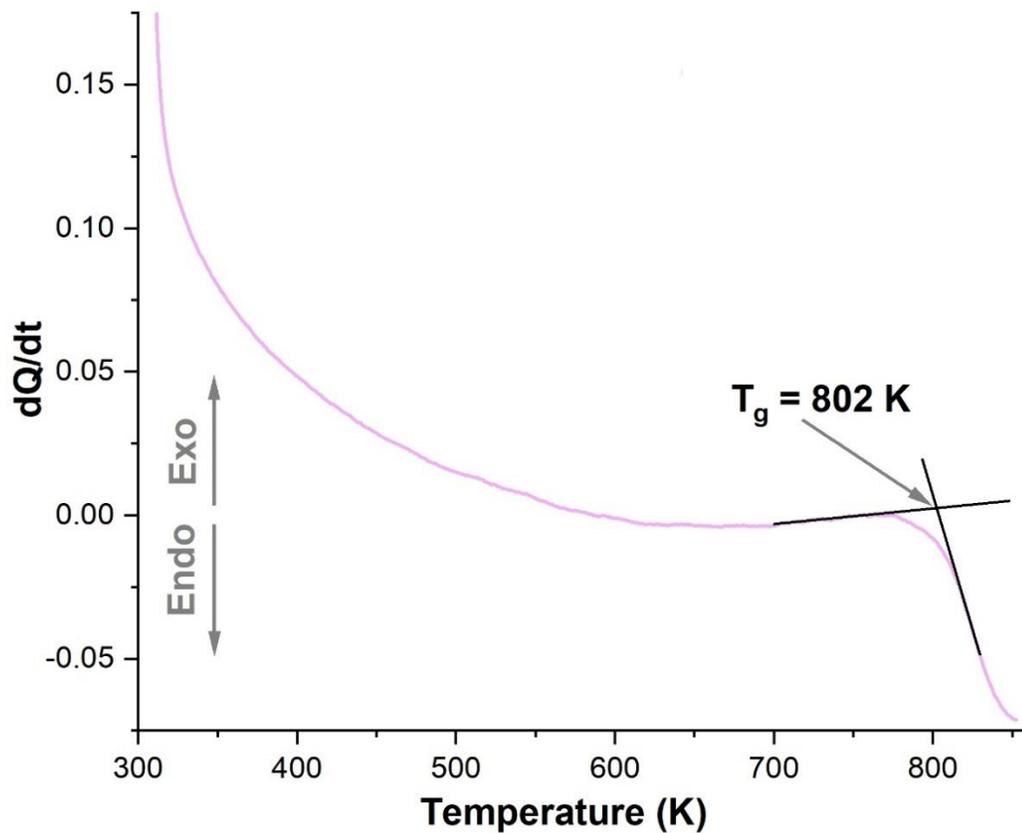
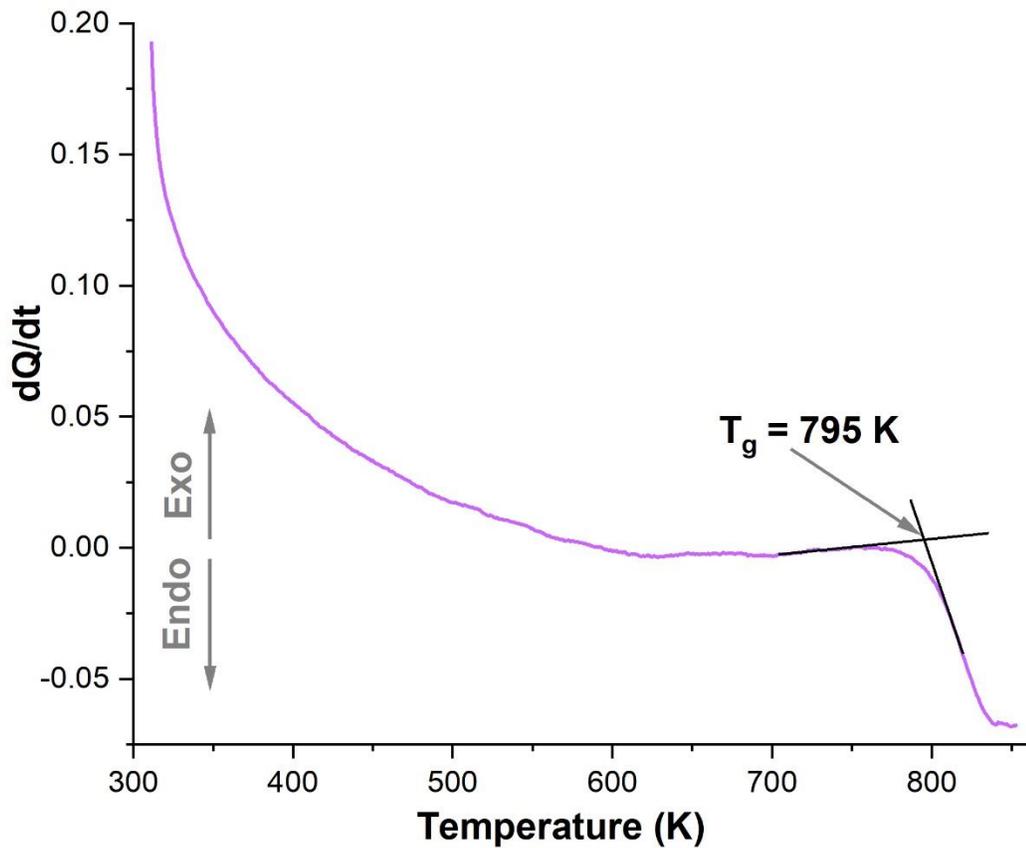
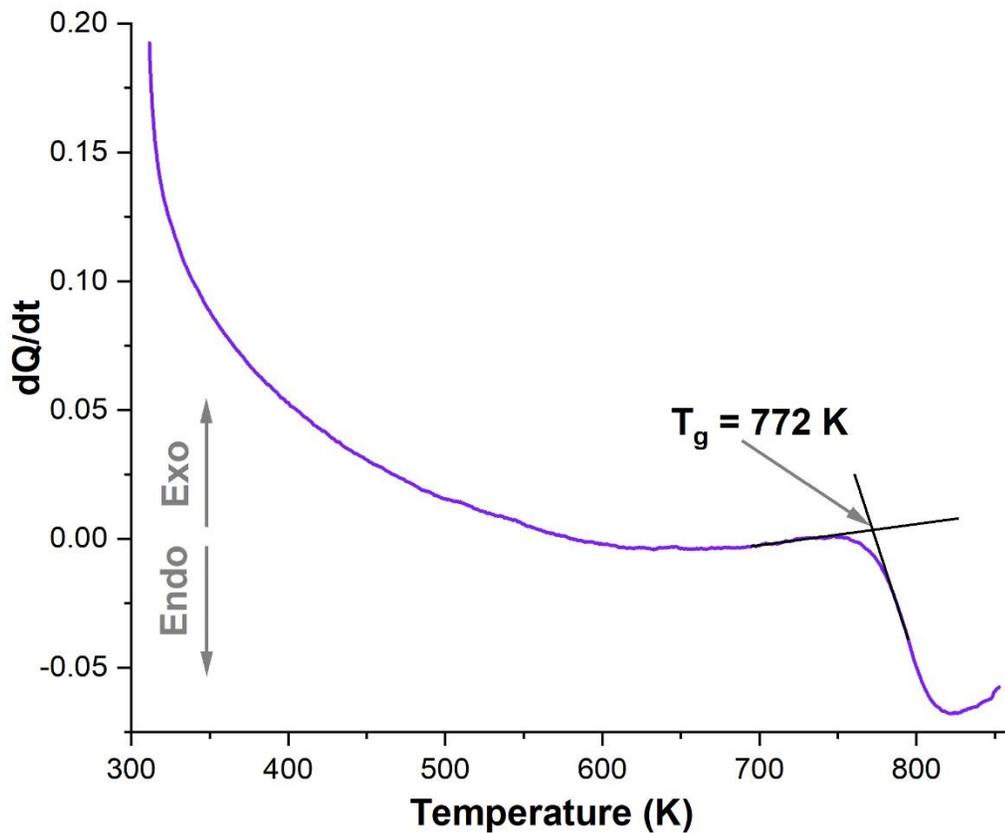


Figure S15. DSC curve for glass composition (11.25)Bi(2.25)Sm(1.5)Gd-42.5 and glass transition temperature.



**Figure S16.** DSC curve for glass composition (12)Bi(1.875)Sm(1.125)Gd-42.5 and glass transition temperature.



**Figure S17.** DSC curve for glass composition (12.75)Bi(1.5)Sm(0.75)Gd-42.5 and glass transition temperature.

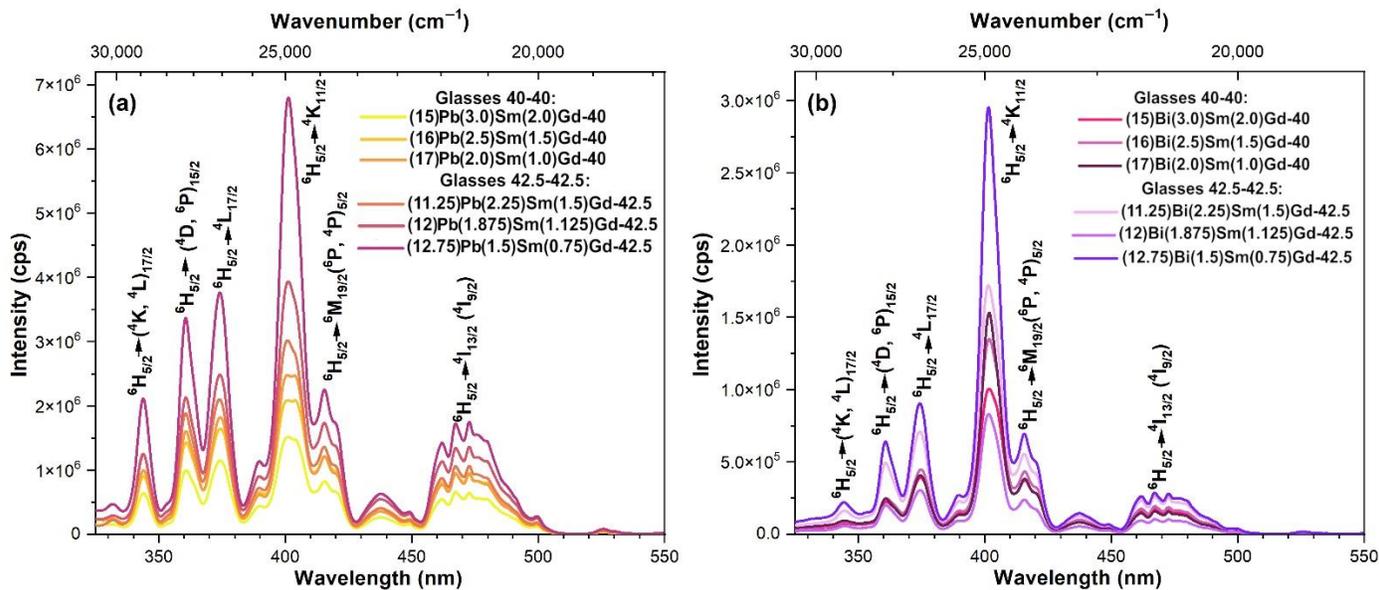


Figure S18. Excitation ( $\lambda^{\text{em}} = 595 \text{ nm}$ ) spectra of (15-17)Pb/Bi(3-2)Sm(2-1)Gd-40 and (11.25-12.75)Pb/Bi(2.25-1.5)Sm(1.5-0.75)Gd-42.5 glasses.

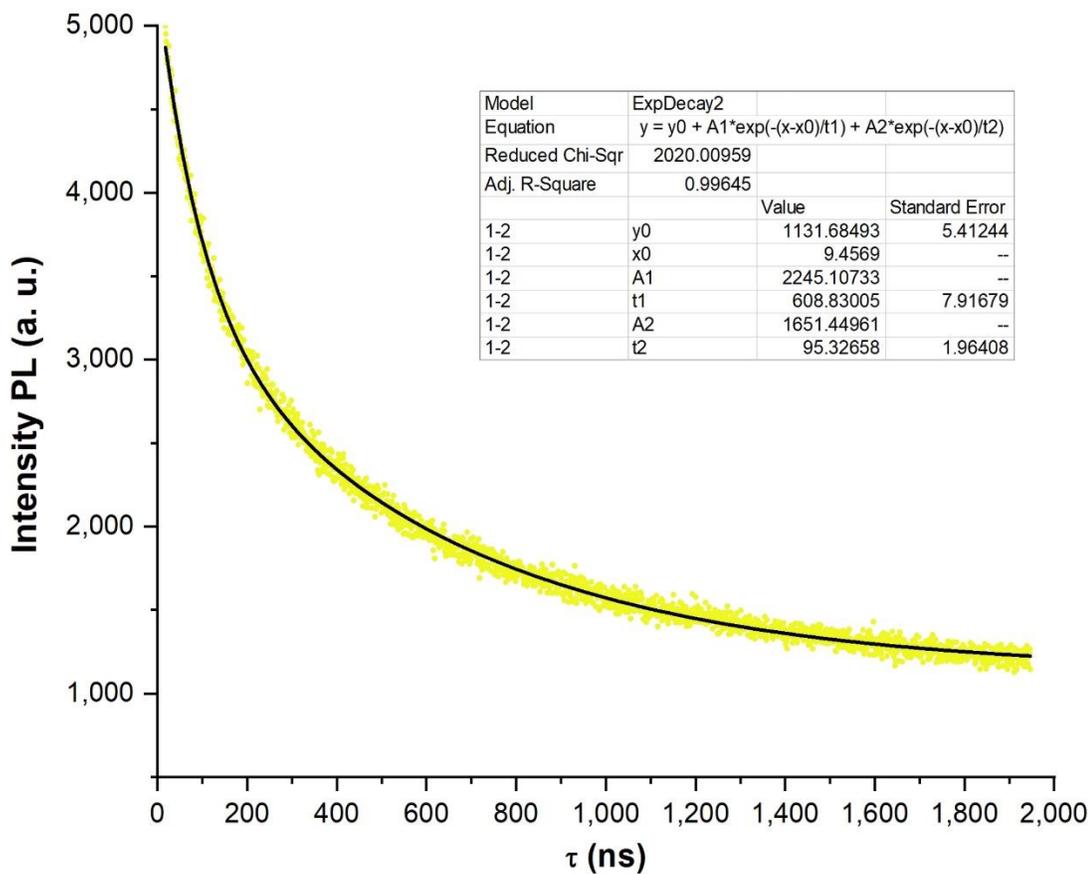


Figure S19. Time resolved PL decay curve of (15)Pb(3)Sm(2)Gd-40 glass ( $\lambda^{\text{PL}} = 597 \text{ nm}$ ).

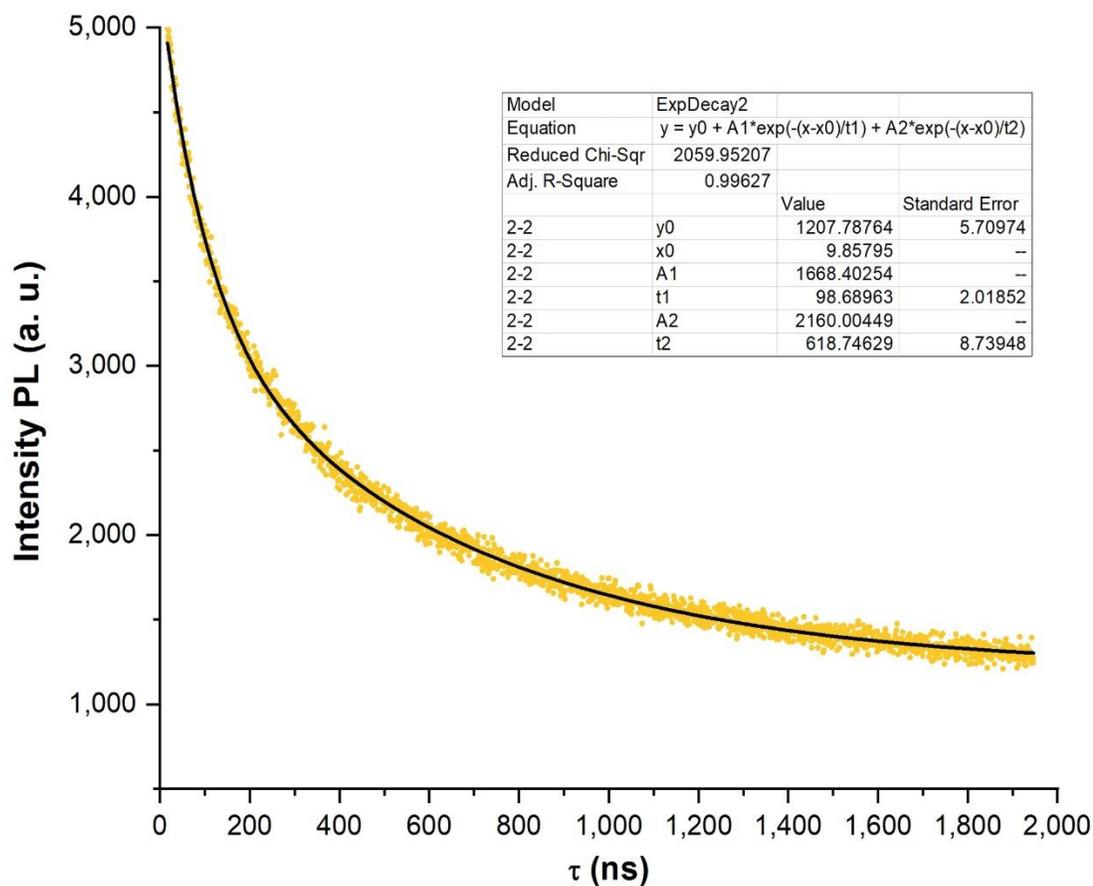


Figure S20. Time resolved PL decay curve of (16)Pb(2.5)Sm(1.5)Gd-40 ( $\lambda^{PL} = 597$  nm).

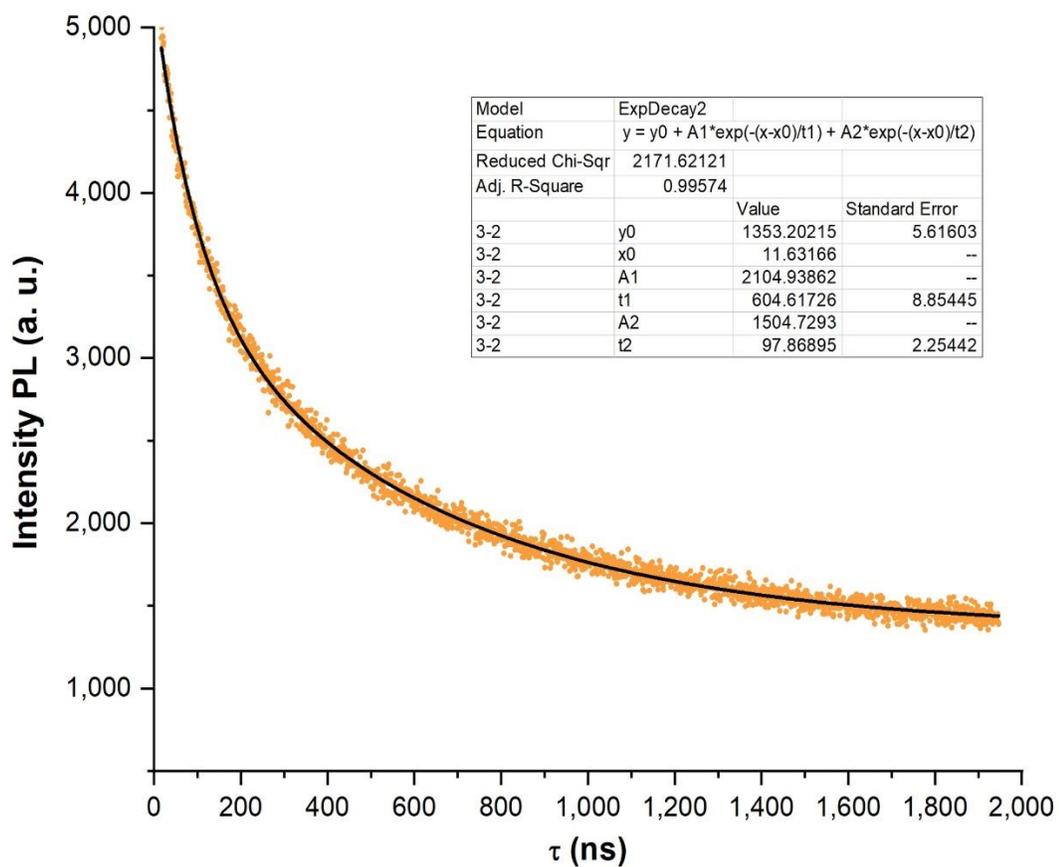


Figure S21. Time resolved PL decay curve of (17)Pb(2)Sm(1)Gd-40 glass ( $\lambda^{PL} = 597$  nm).

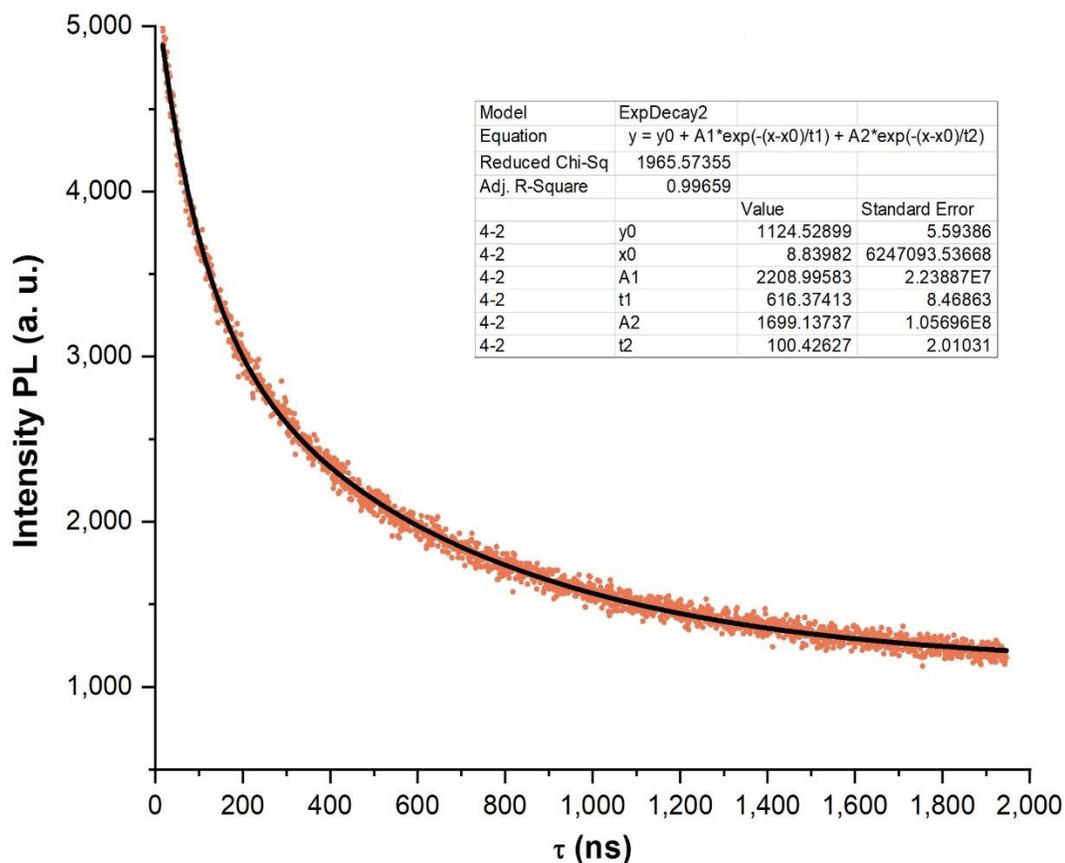


Figure S22. Time resolved PL decay curve of (11.25)Pb(2.25)Sm(1.5)Gd-42.5 glass ( $\lambda^{PL} = 597$  nm).

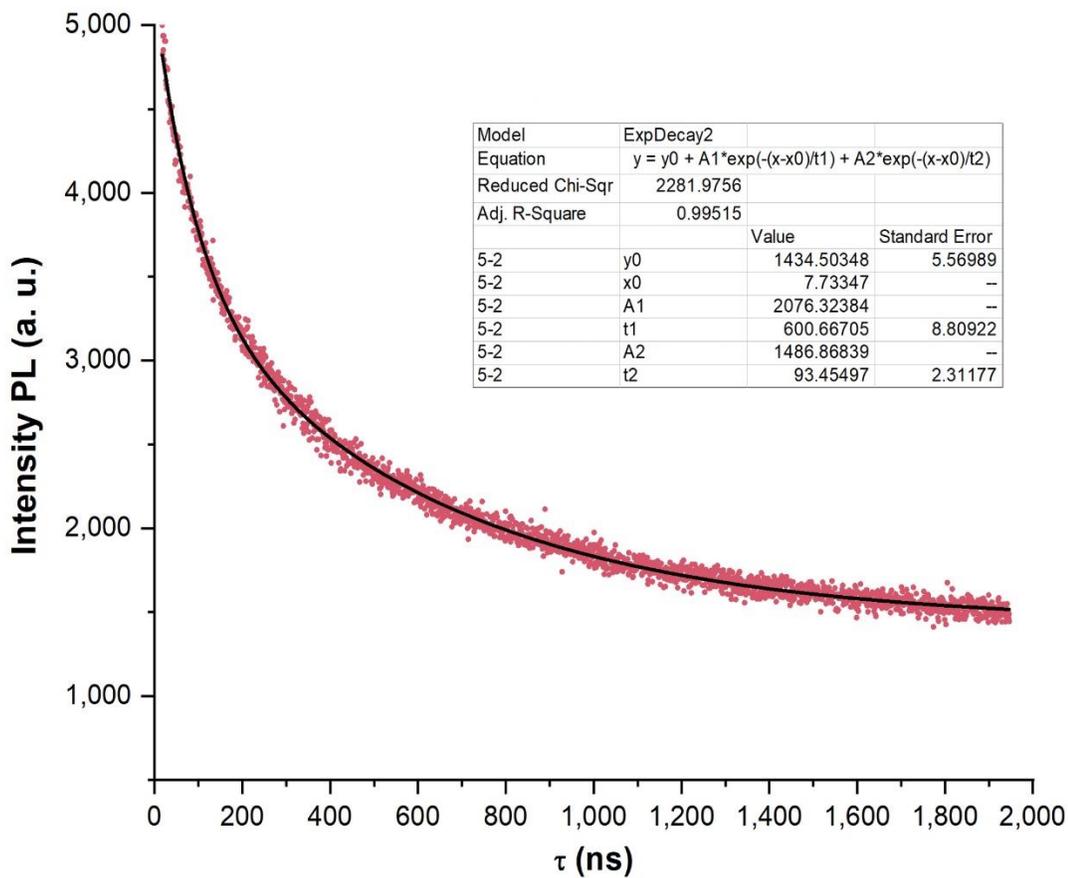


Figure S23. Time resolved PL decay curve of (12)Pb(1.875)Sm(1.125)Gd-42.5 glass ( $\lambda^{PL} = 597$  nm).

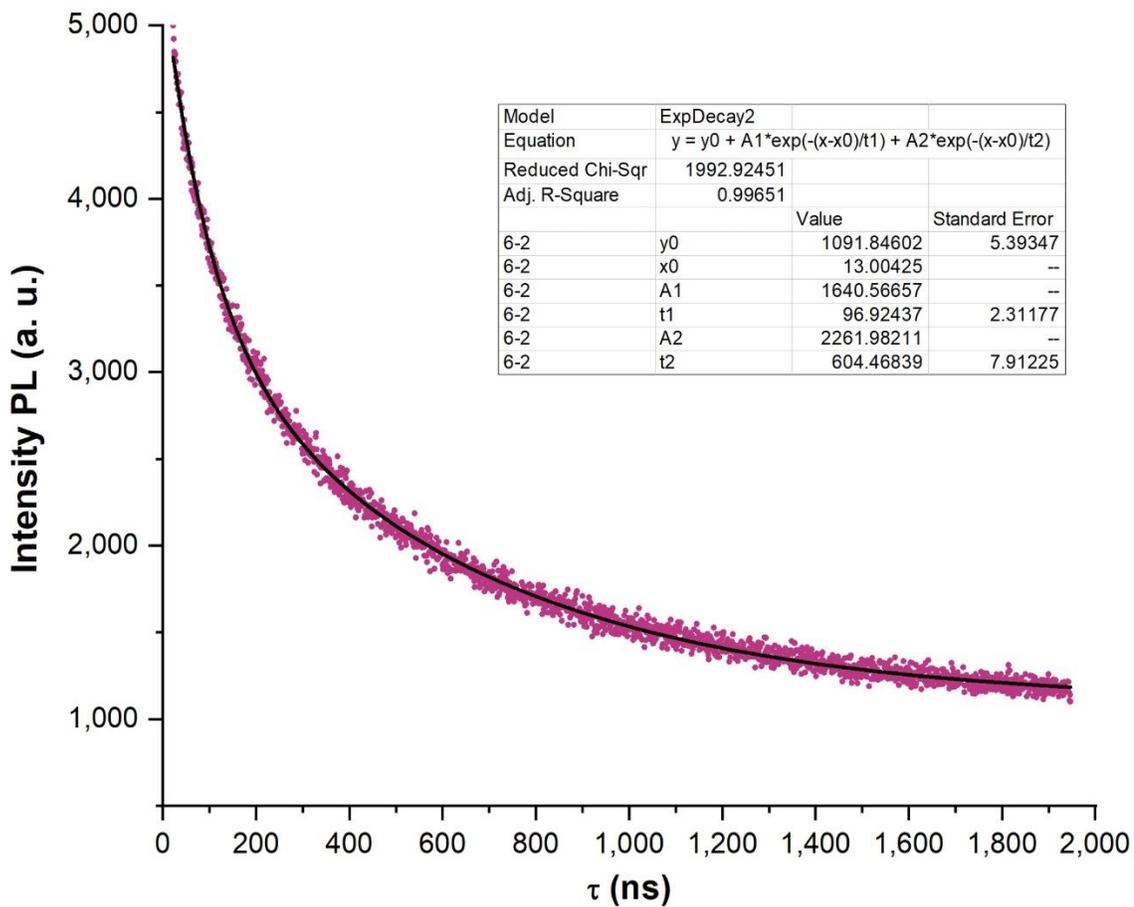


Figure S24. Time resolved PL decay curve of (12.75)Pb(1.5)Sm(0.75)Gd-42.5 glass ( $\lambda^{PL} = 597$  nm).

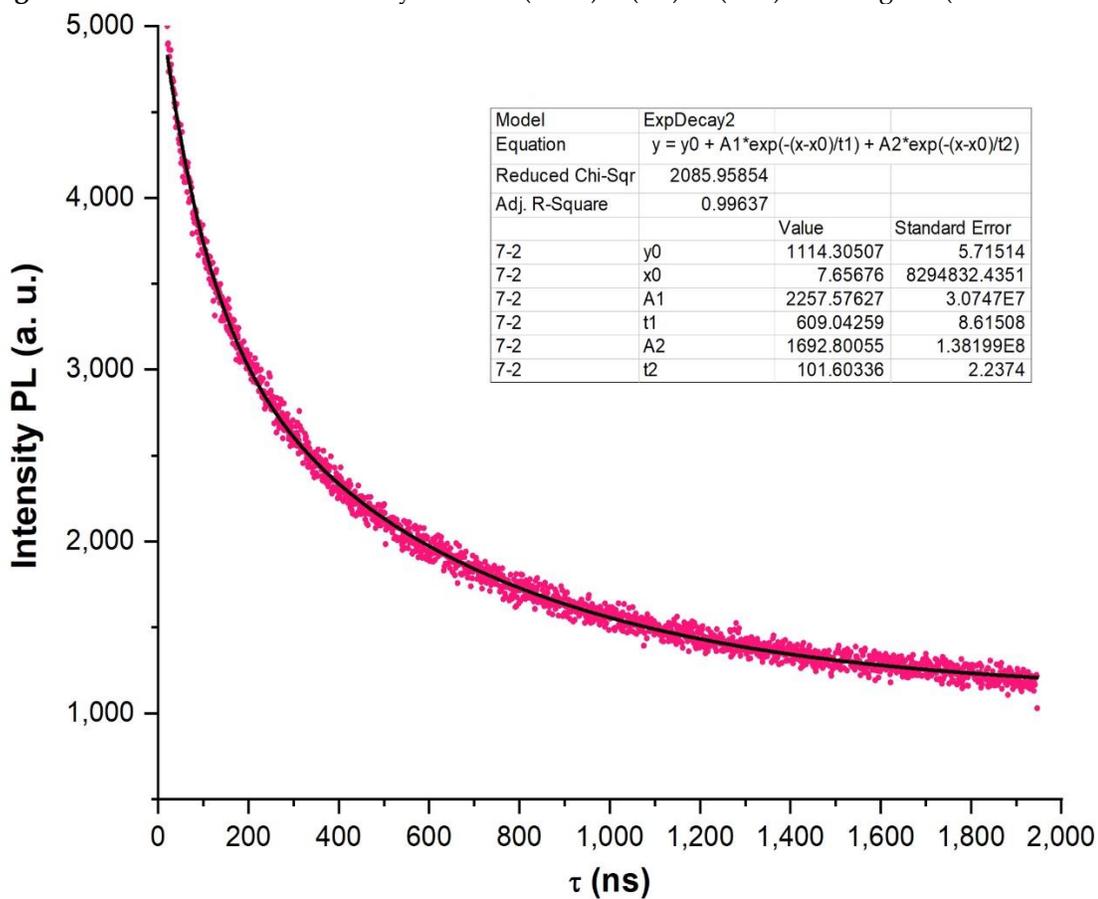


Figure S25. Time resolved PL decay curve of (15)Bi(3)Sm(2)Gd-40 ( $\lambda^{PL} = 597$  nm).

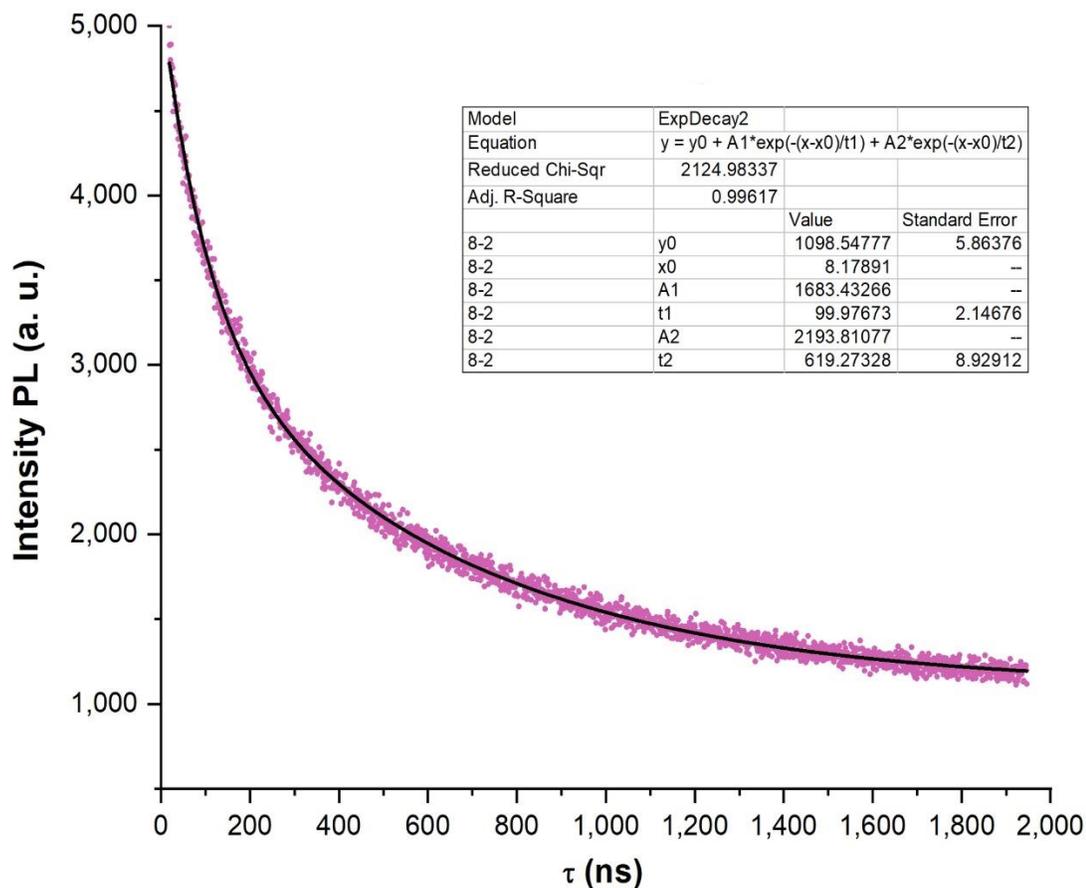


Figure S26. Time resolved PL decay curve of (16)Bi(2.5)Sm(1.5)Gd-40 glass ( $\lambda^{PL} = 597$  nm).

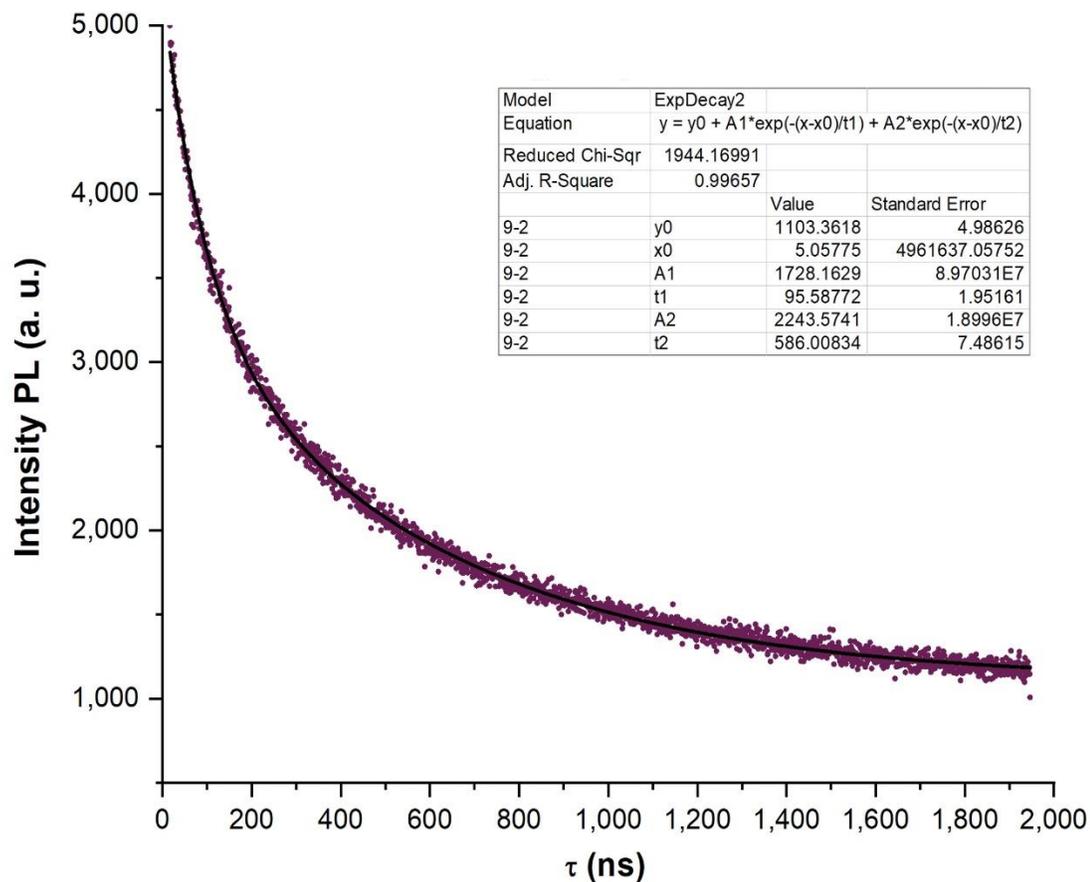


Figure S27. Time resolved PL decay curve of (17)Bi(2)Sm(1)Gd-40 glass ( $\lambda^{PL} = 597$  nm).

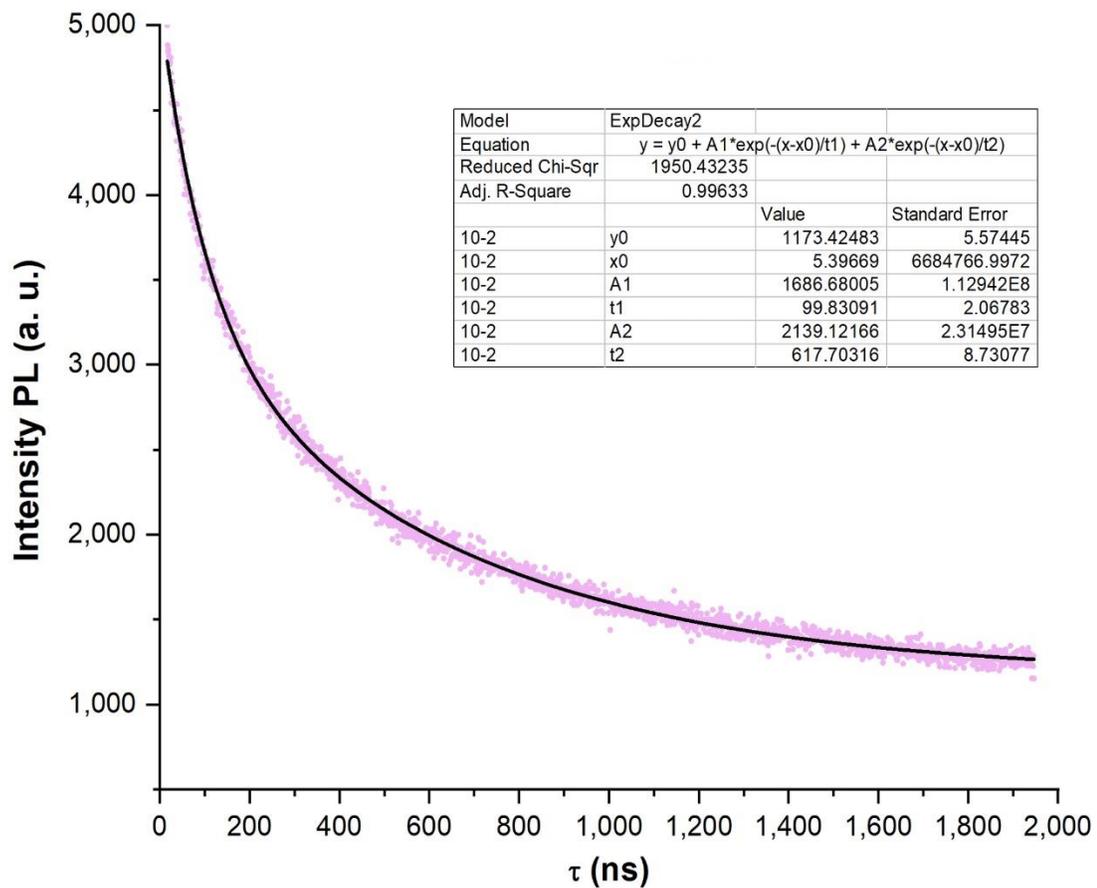


Figure S28. Time resolved PL decay curve of (11.25)Bi(2.25)Sm(1.5)Gd-42.5 glass ( $\lambda^{PL} = 597$  nm).

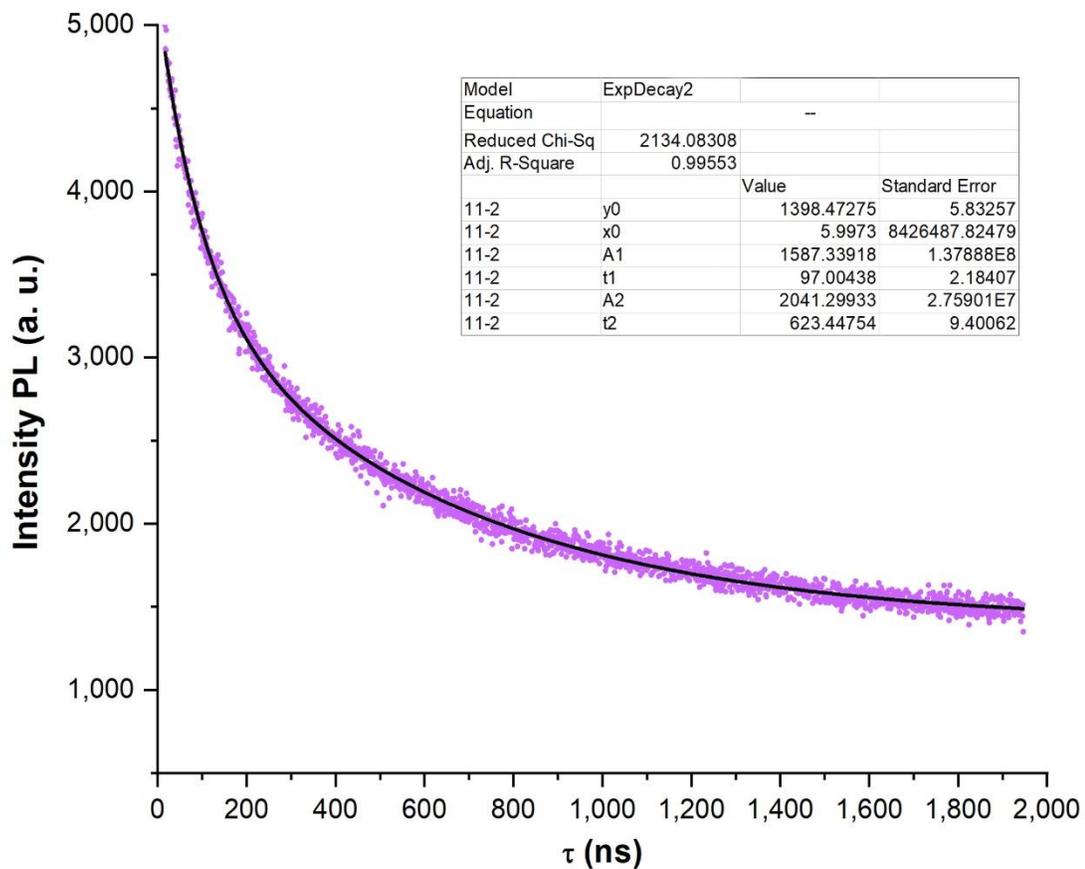


Figure S29. Time resolved PL decay curve of (12)Bi(1.875)Sm(1.125)Gd-42.5 glass ( $\lambda^{PL} = 597$  nm).

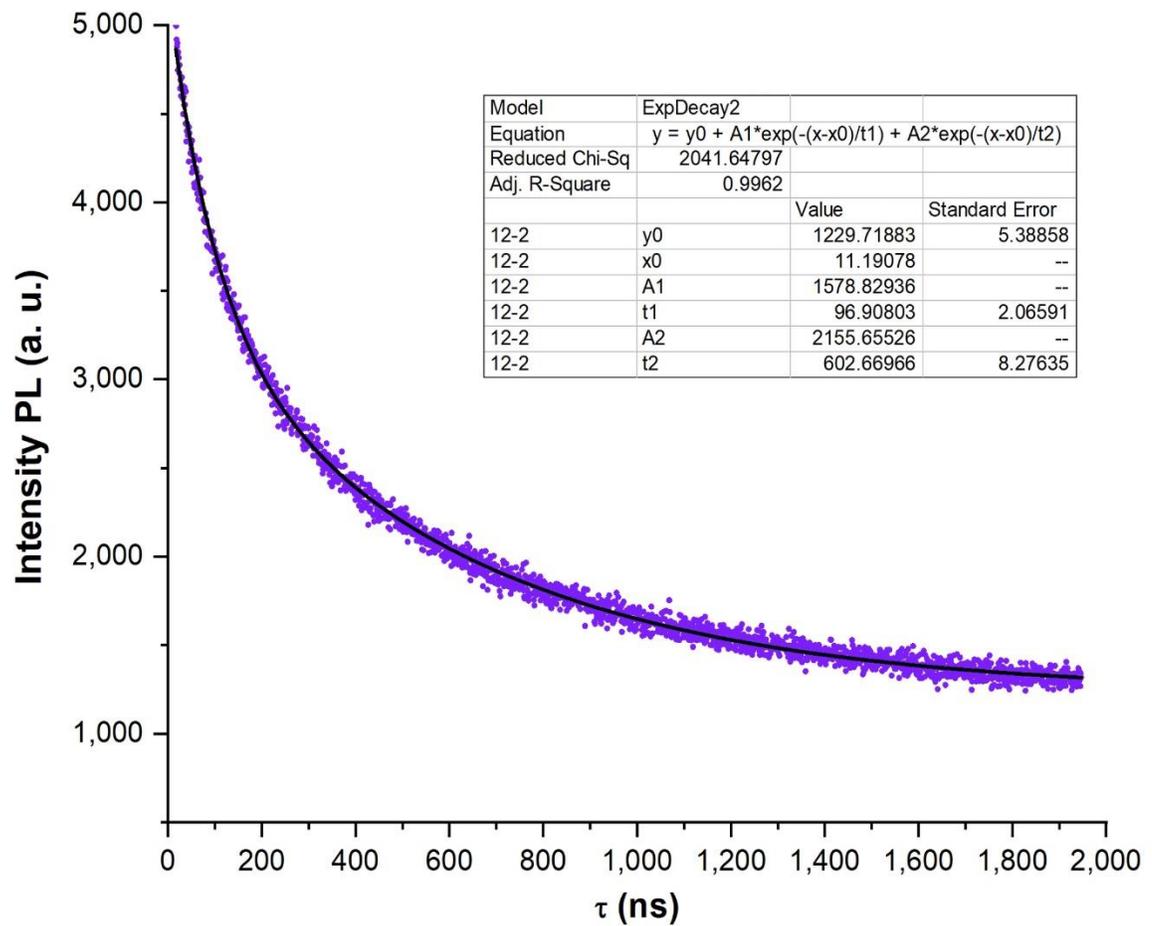


Figure S30. Time resolved PL decay curve of (12.75)Bi(1.5)Sm(0.75)Gd-42.5 glass ( $\lambda_{PL} = 597$  nm).

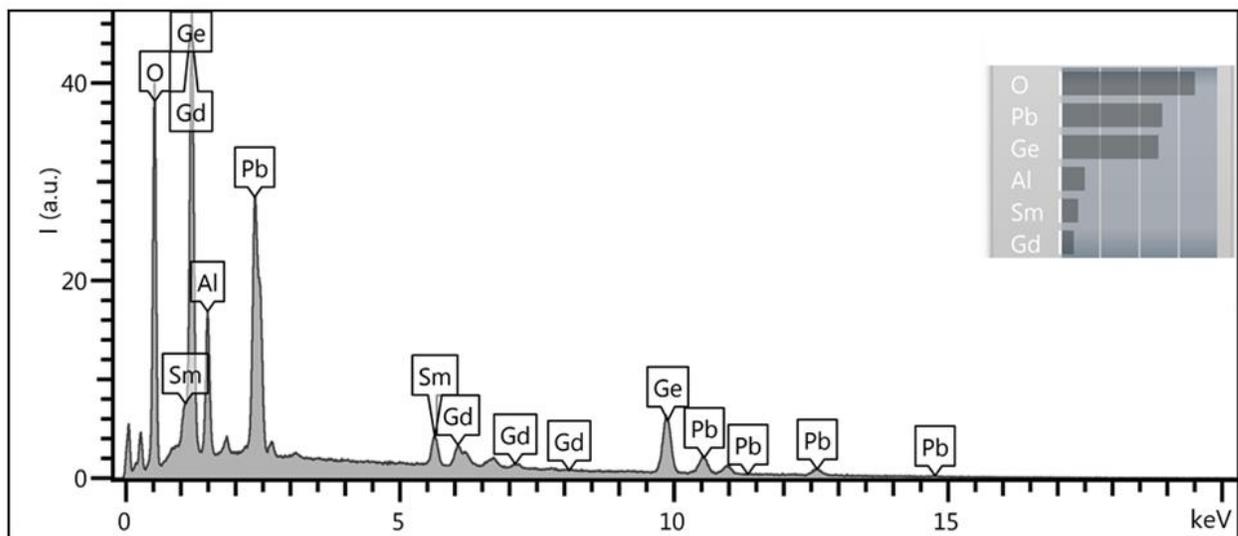


Figure S31. EDS spectra of (15)Pb(3)Sm(2)Gd-40 glass composition.

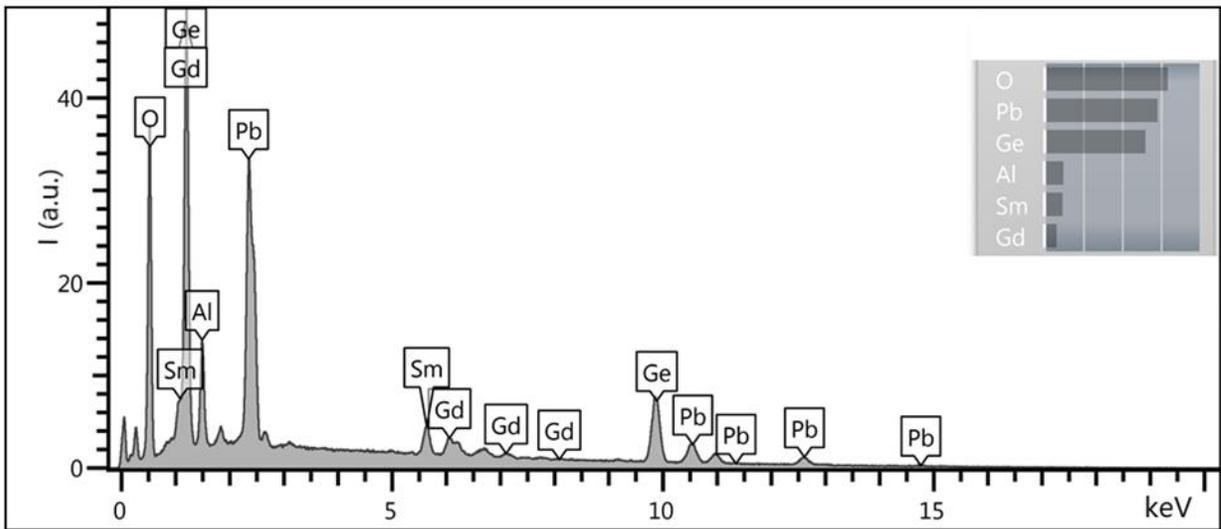


Figure S32. EDS spectra of (16)Pb(2.5)Sm(1.5)Gd-40 glass composition.

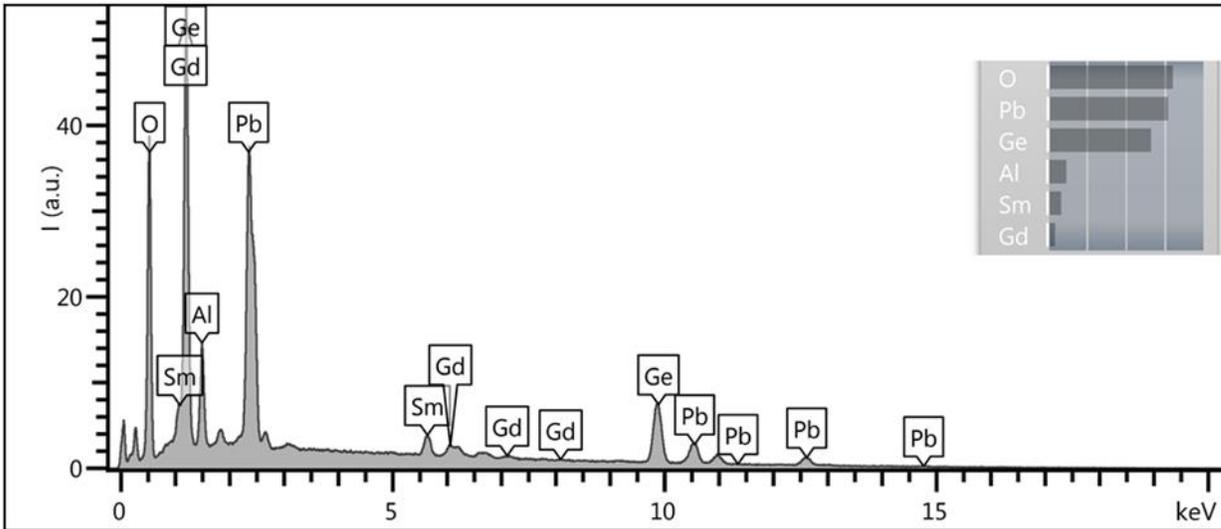


Figure S33. EDS spectra of (17)Pb(2)Sm(1)Gd-40 glass composition.

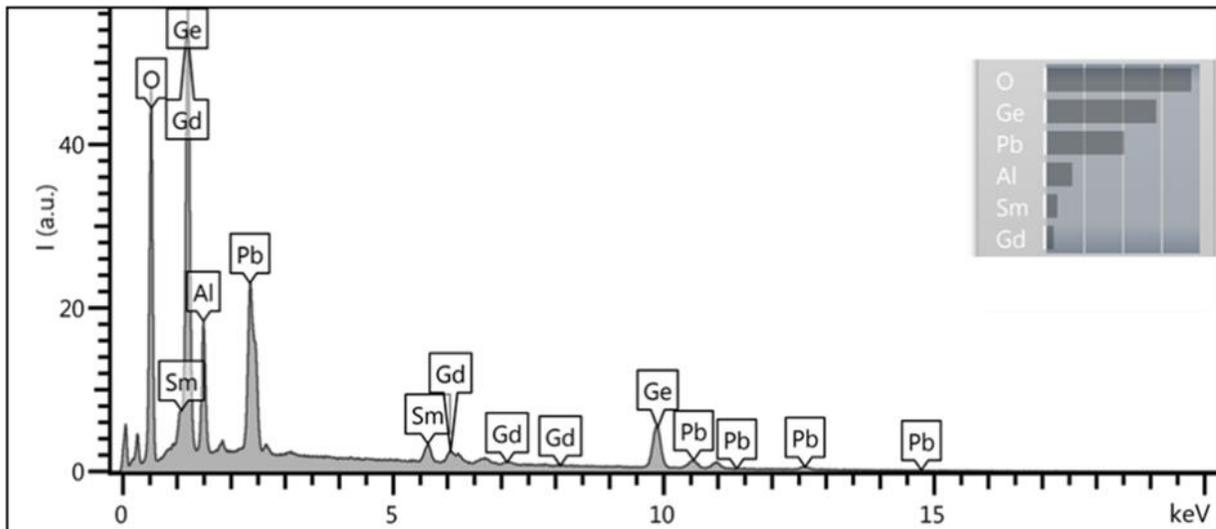


Figure S34. EDS spectra of (11.25)Pb(2.25)Sm(1.5)Gd-42.5 glass composition.

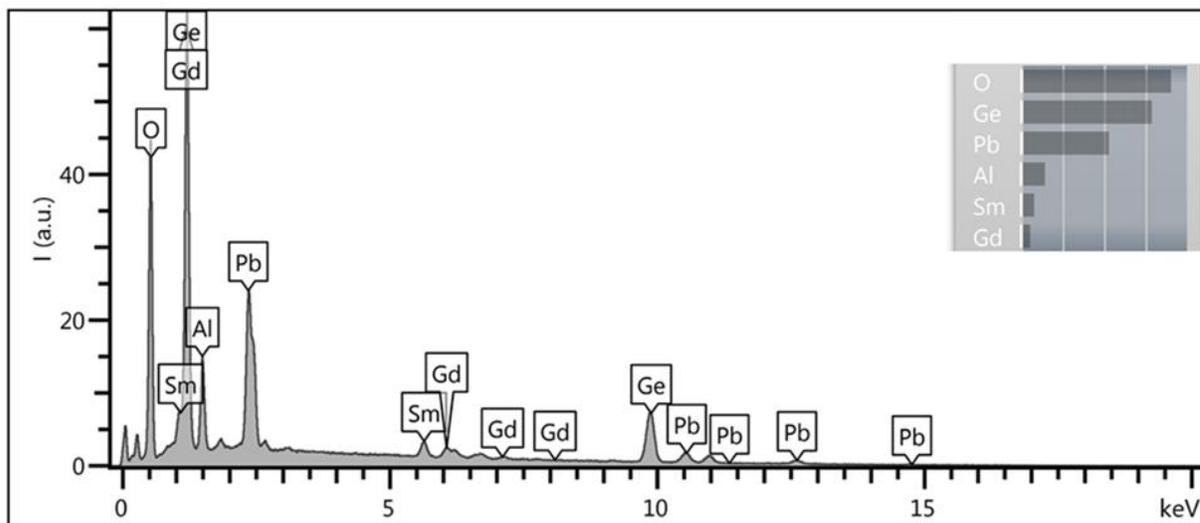


Figure S35. EDS spectra of (12)Pb(1.875)Sm(1.125)Gd-42.5 glass composition.

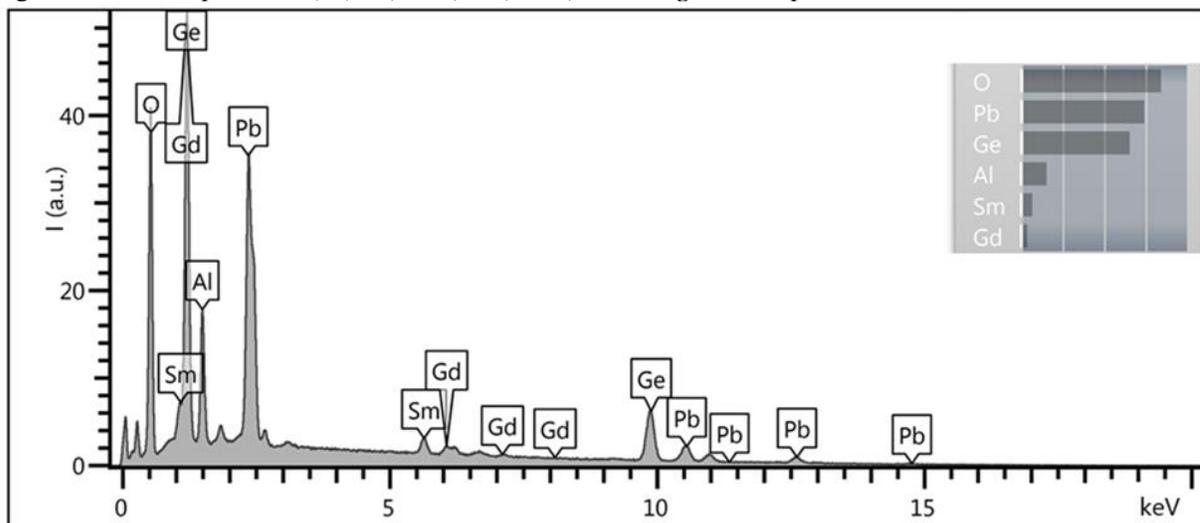


Figure S36. EDS spectra of (12.75)Pb(1.5)Sm(0.75)Gd-42.5 glass composition.

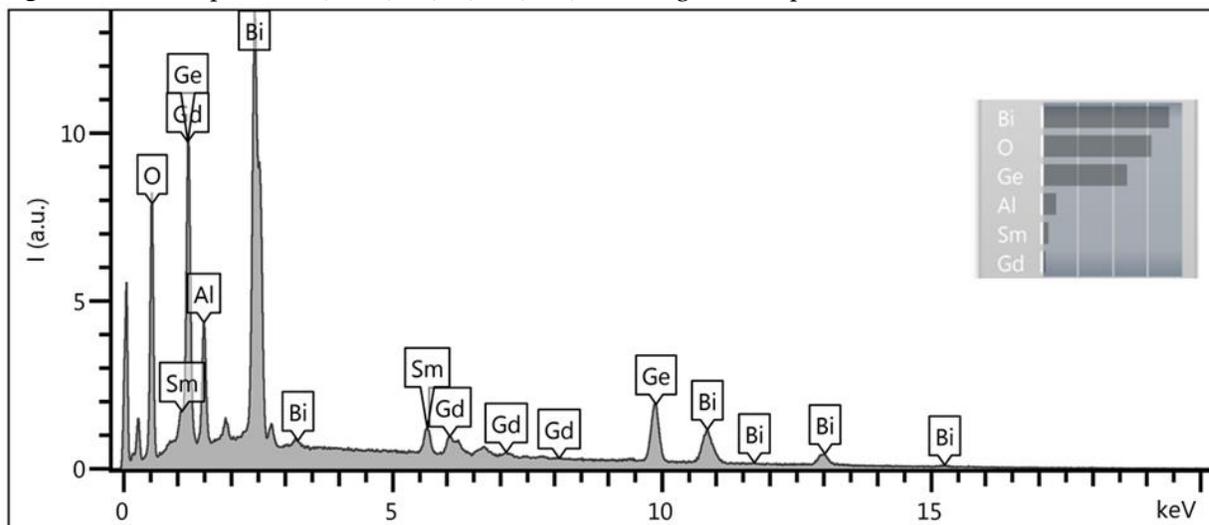


Figure S37. EDS spectra of (15)Bi(3)Sm(2)Gd-40 glass composition.

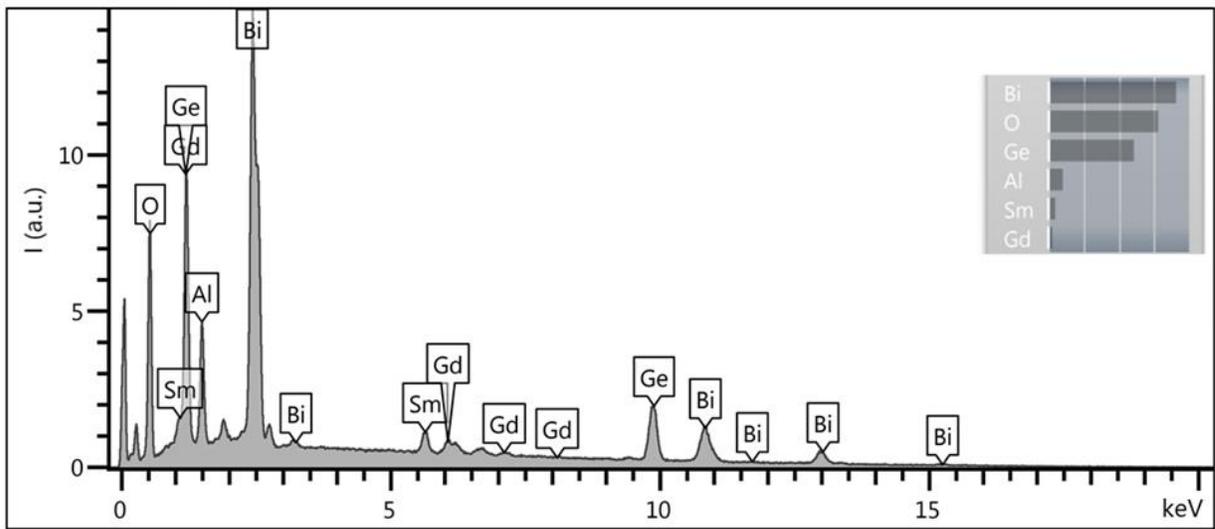


Figure S38. EDS spectra of (16)Bi(2.5)Sm(1.5)Gd-40 glass composition.

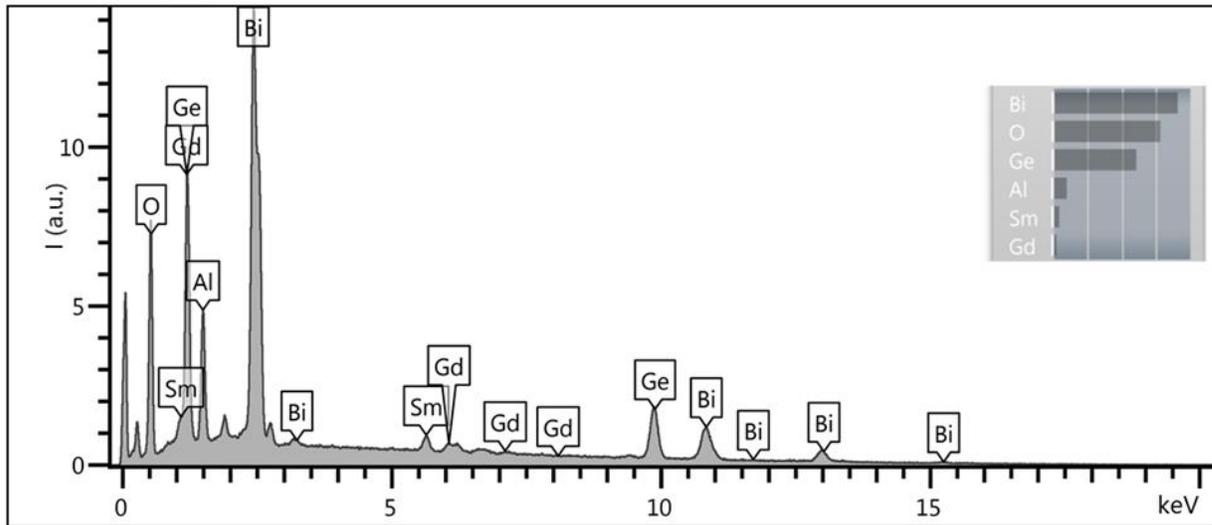


Figure S39. EDS spectra of (17)Bi(2)Sm(1)Gd-40 glass composition.

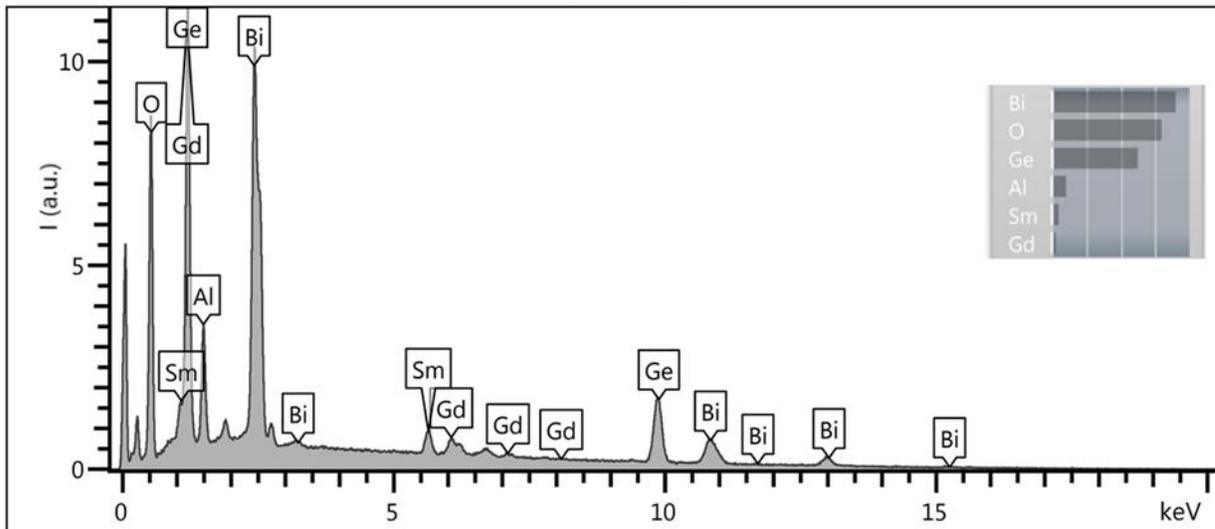


Figure S40. EDS spectra of (11.25)Bi(2.25)Sm(1.5)Gd-42.5 glass composition.

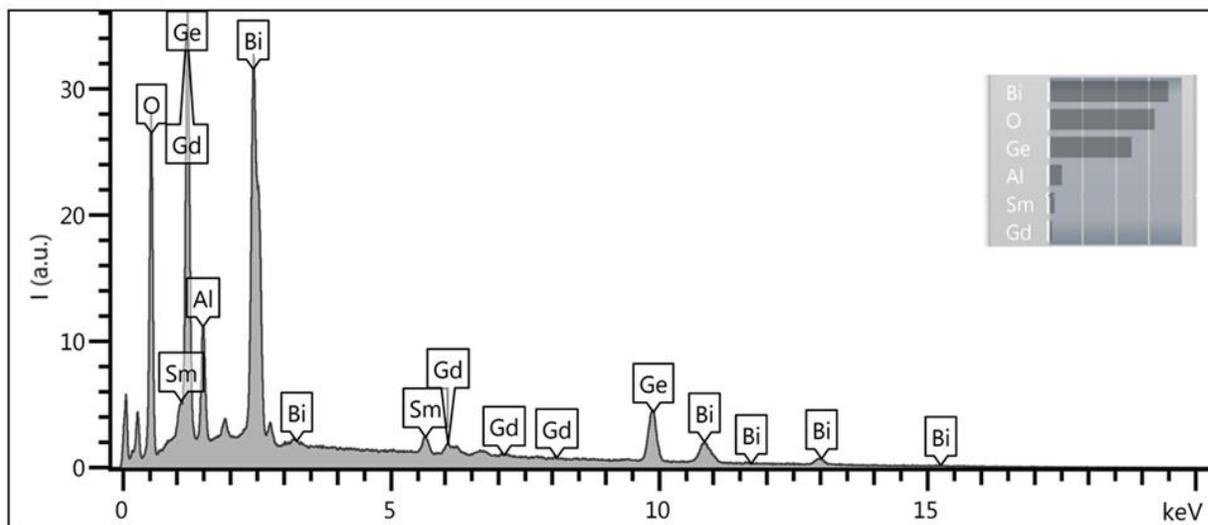


Figure S41. EDS spectra of (12)Bi(1.875)Sm(1.125)Gd-42.5 glass composition.

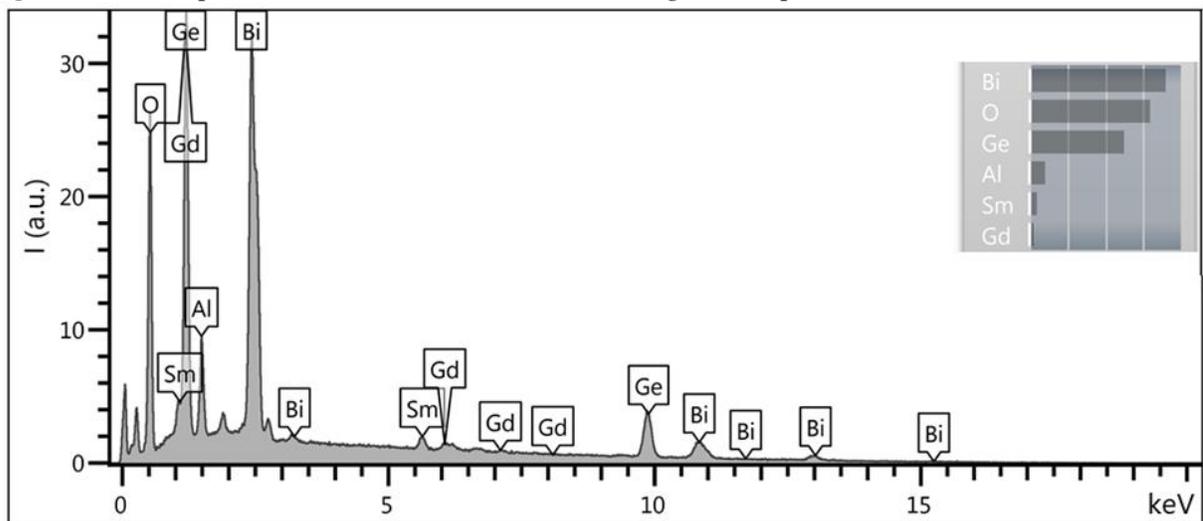


Figure S42. EDS spectra of (12.75)Pb(1.5)Sm(0.75)Gd-42.5 glass composition.

Table S1. The composition of glasses according to the EDS data.

Sample ID	Ge content (at.%)	Pb content (at.%)	Sm content (at.%)	Gd content (at.%)	O content (at.%)	Al content (at.%)
(12.75)Pb(1.5)Sm(0.75)Gd-42.5	12.57±0.15	4.94±0.08	0.63±0.02	0.33±0.08	73.49±0.14	8.05±0.18
(12)Pb(1.875)Sm(1.125)Gd-42.5	14.11±0.34	3.52±0.13	0.72±0.04	0.46±0.03	74.23±0.71	6.95±0.91
(11.25)Pb(2.25)Sm(1.5)Gd-42.5	13.20±0.38	3.25±0.17	0.78±0.10	0.54±0.06	74.65±0.35	7.57±0.50
(17)Pb(2.0)Sm(1.0)Gd-40	13.48±0.11	5.55±0.05	0.91±0.03	0.48±0.02	72.95±0.18	6.62±0.12
(16)Pb(2.5)Sm(1.5)Gd-40	12.95±0.27	5.10±0.09	1.11±0.04	0.71±0.04	73.03±0.27	7.10±0.42
(15)Pb(3.0)Sm(2.0)Gd-40	11.70±0.17	4.19±0.08	1.04±0.03	0.75±0.04	73.88±0.25	8.43±0.30
Sample ID	Ge content (at.%)	Bi content (at.%)	Sm content (at.%)	Gd content (at.%)	O content (at.%)	Al content (at.%)
(12.75)Bi(1.5)Sm(0.75)Gd-42.5	12.82±0.10	6.45±0.14	0.48±0.02	0.26±0.02	74.36±0.24	5.63±0.17
(12)Bi(1.875)Sm(1.125)Gd-42.5	12.29±0.15	5.95±0.13	0.60±0.04	0.38±0.03	74.09±0.34	6.7±0.05
(11.25)Bi(2.25)Sm(1.5)Gd-42.5	12.39±0.38	6.30±0.08	0.92±0.04	0.65±0.02	72.90±0.21	6.84±0.13
(17)Bi(2.0)Sm(1.0)Gd-40	10.73±0.13	8.79±0.12	0.78±0.02	0.42±0.02	70.59±0.24	8.68±0.18
(16)Bi(2.5)Sm(1.5)Gd-40	10.76±0.12	8.61±0.11	1.04±0.03	0.67±0.04	73.03±0.27	7.10±0.42
(15)Bi(3.0)Sm(2.0)Gd-40	10.74±0.09	7.99±0.11	1.25±0.04	0.87±0.03	71.40±0.26	7.76±0.08