COST MP1401 Annual Conference and 2nd MC meeting
12-15 April 2016, Zadar, Croatia

VIS-NIR luminescence in RE co-doped antimony-germanate glasses and glass - ceramics

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Research Infrastructures

POLISH ROADMAPS FOR RESEARCH INFRASTRUCTURES

Outline

- Antimony-germanate glasses and glass-ceramics
- Thermal and luminescent properties
- Conclusions and perspectives

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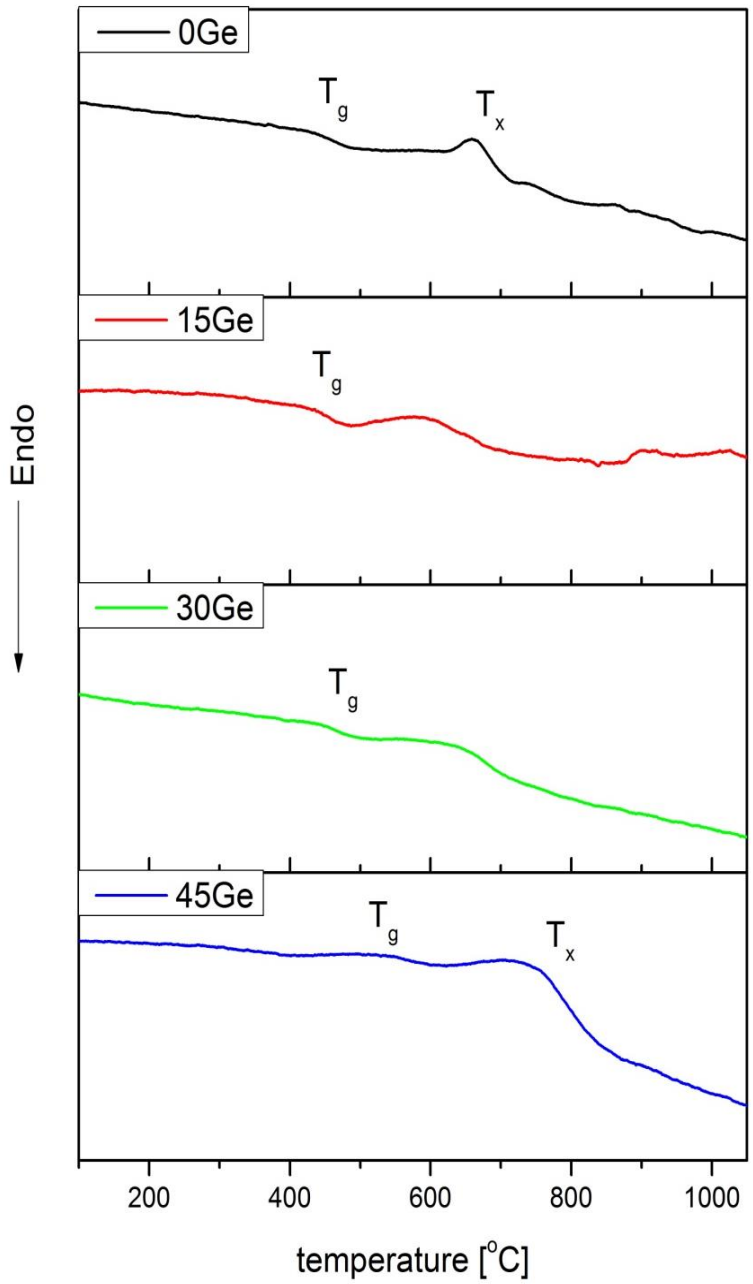
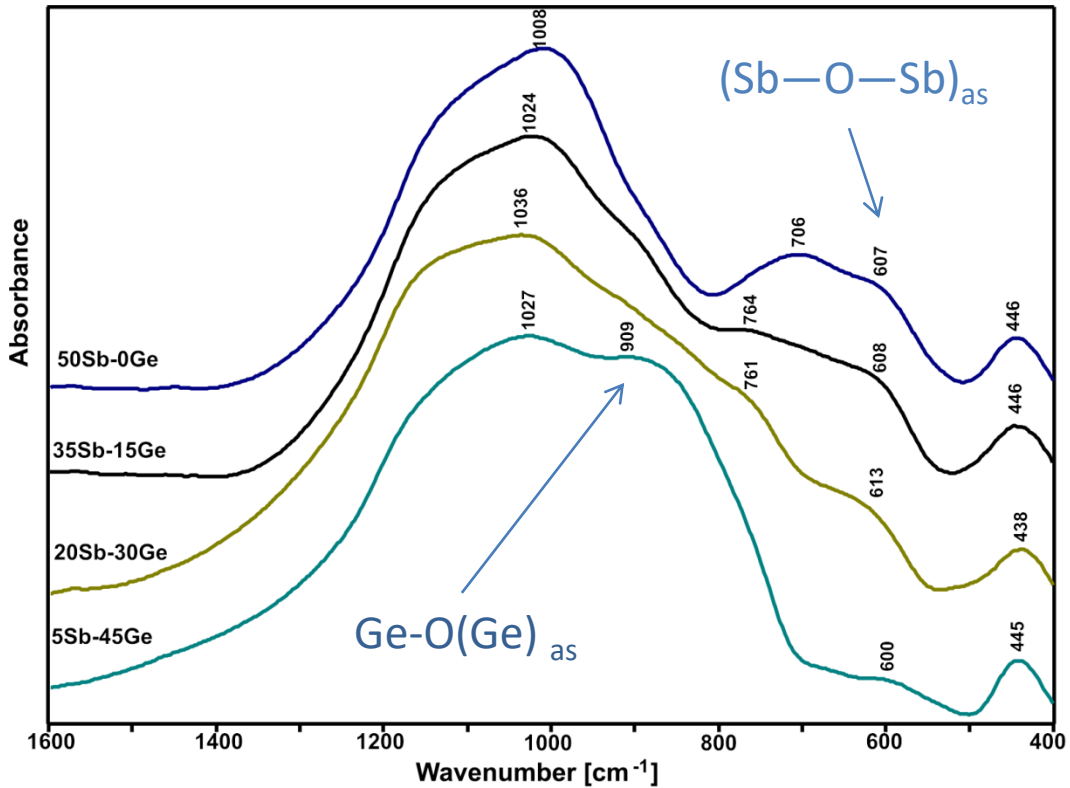
Effect of GeO_2 content on thermal and optical properties of RED antimony glasses

SGS glass: $(50\text{-}x)Sb_2O_3 - xGeO_2 - 50SiO_2$

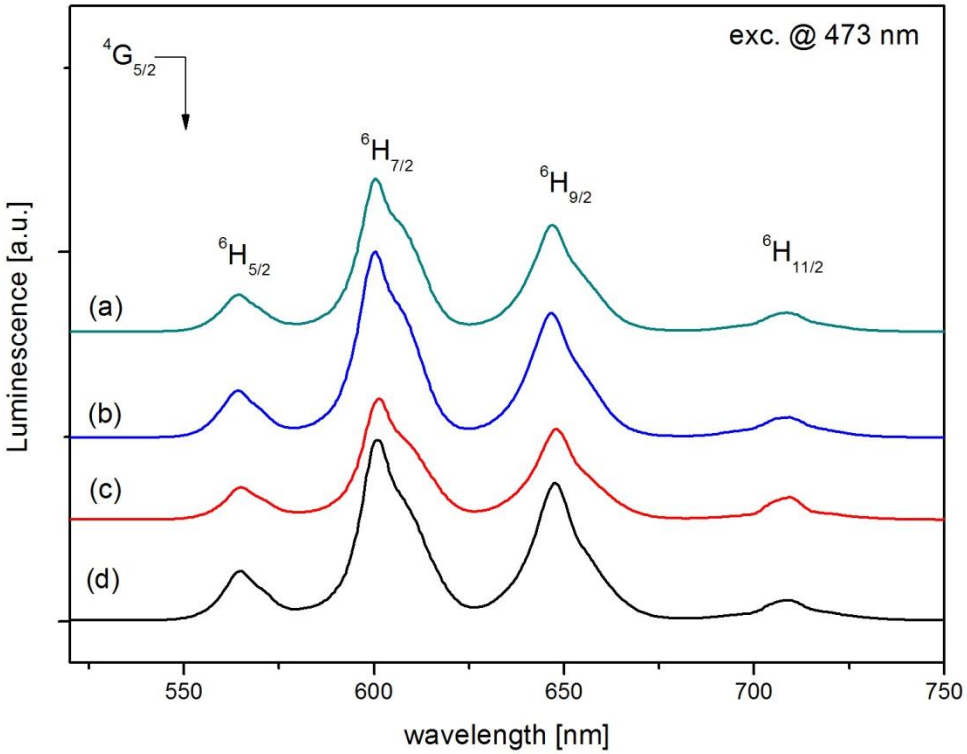


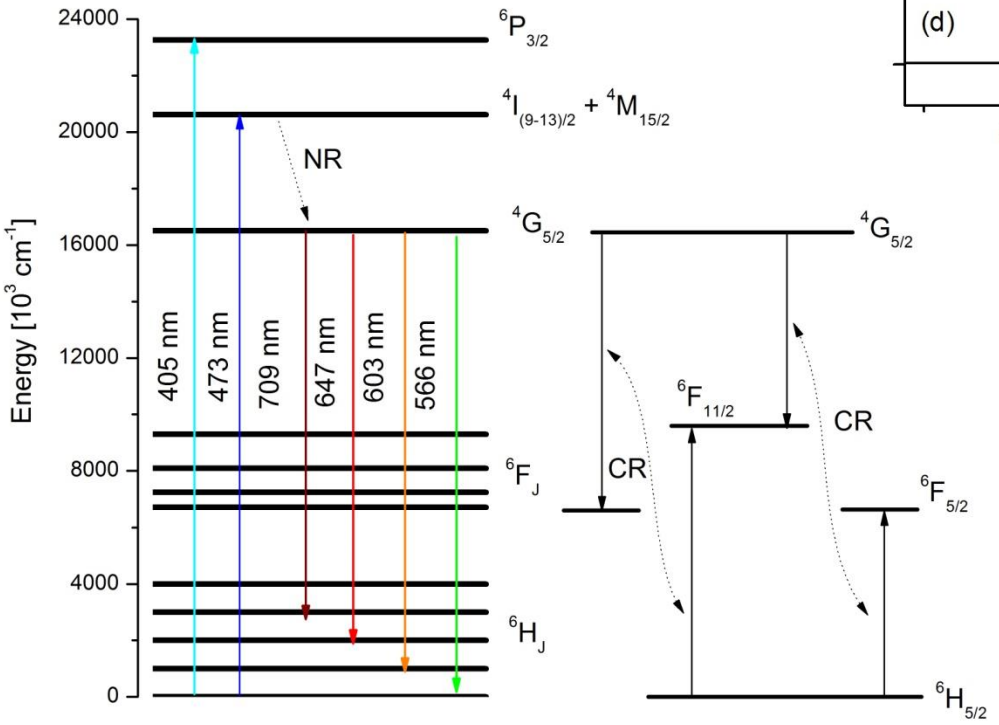
xGeO2	ρ	n	T_g [°C]	T_x [°C]	ΔT[°C]
0	3.66	1.73	432	667	235
15	3.69	1.72	432	600	168
30	3.52	1.68	448	644	296
45	3.35	1.62	552	760	208

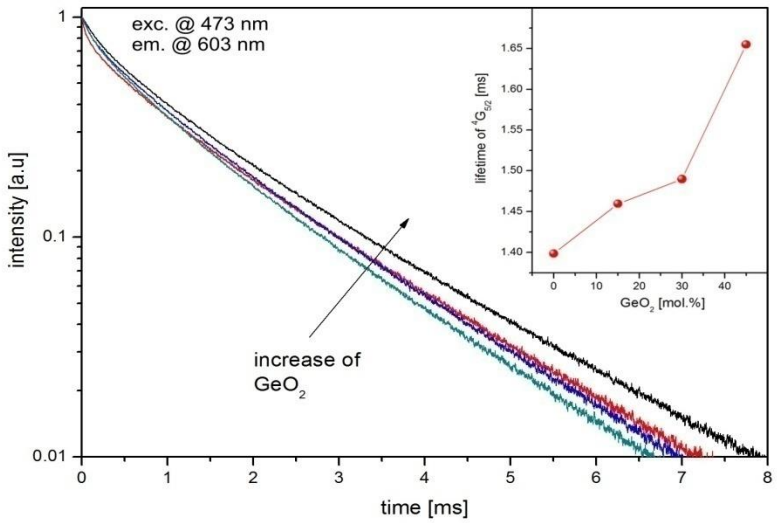


SGS glass: $(50\text{-}x)Sb_2O_3 - xGeO_2 - 50SiO_2 - Sm_2O_3$

xGeO2	O/R ratio
0	1,45
15	1,5
30	1,33
45	1,32

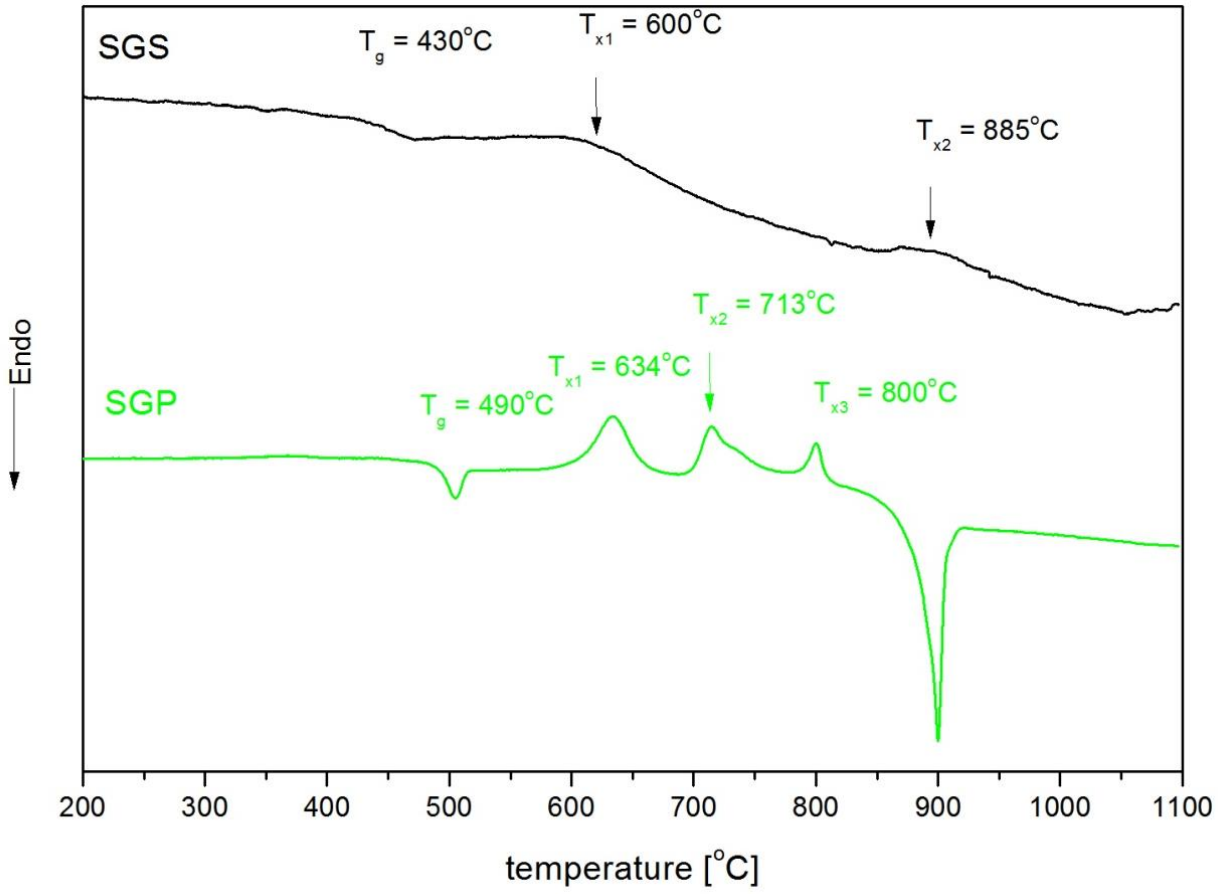






Effect of P_2O_5 and SiO_2 on thermal and optical properties of RED antimony-germanate glasses

SGX glasses: Sb_2O_3- GeO_2- [SiO_2/P_2O_5]

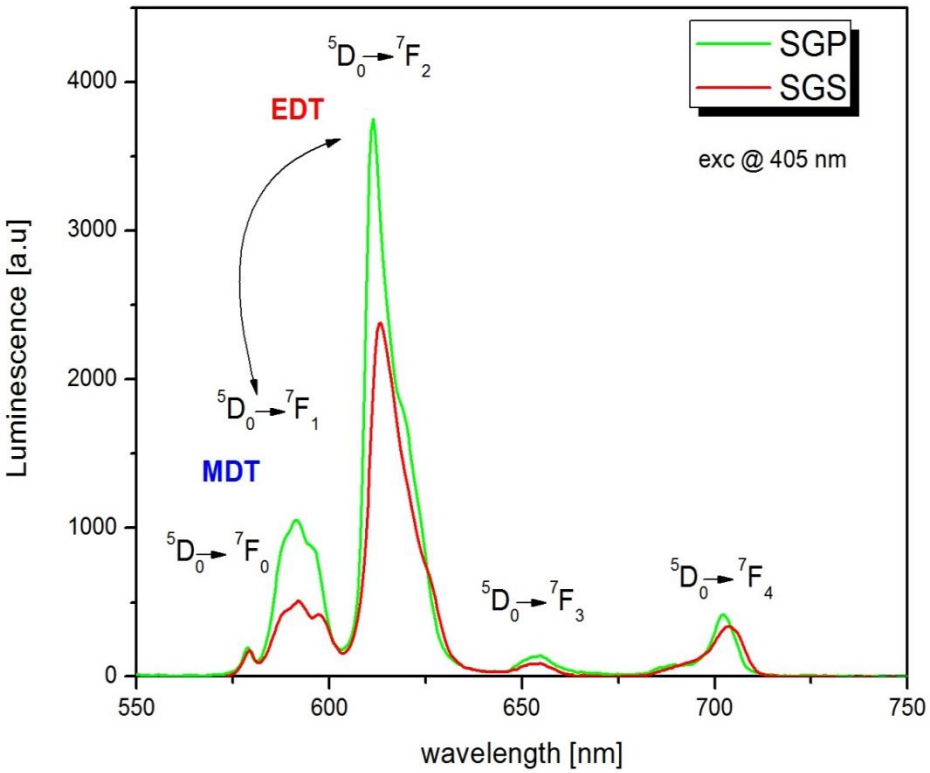


DSC curves of SGX glasses

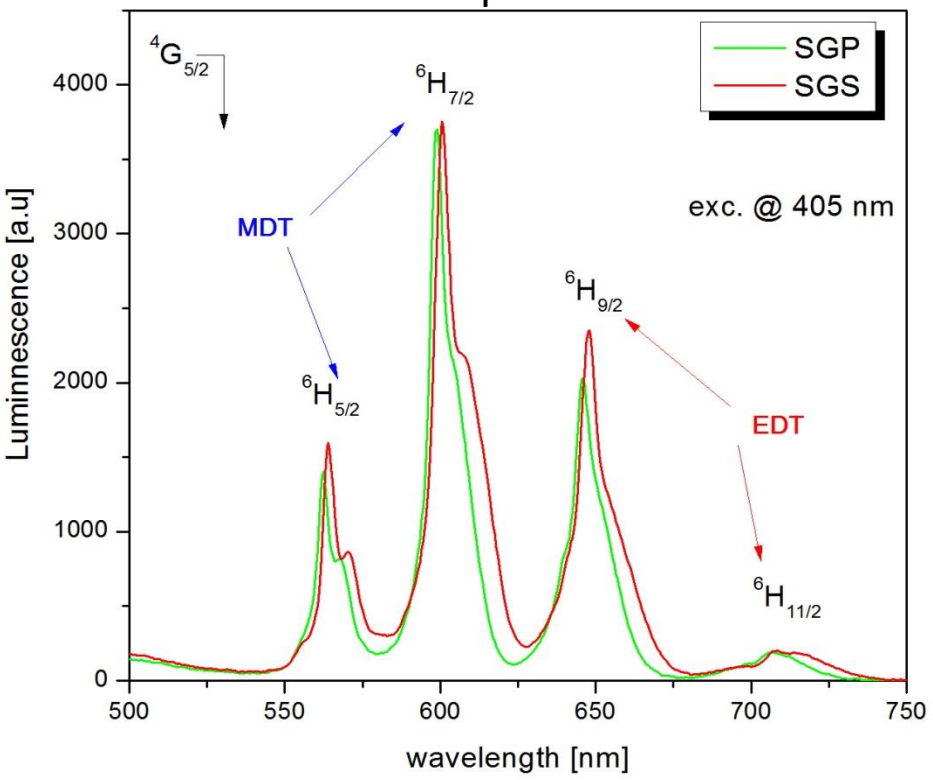
Parameter	SGS	SGP
T_g [°C]	430	490
T_{x1} [°C]	600	634
ΔT [°C]	230	144

SGX glasses: Eu^{3+} and Sm^{3+}

Luminescence spectra of Eu^{3+} ions



Luminescence spectra of Sm^{3+} ions



$$FIR = \frac{EDT\left({}^5D_0 \rightarrow {}^7F_2\right)}{MDT\left({}^5D_0 \rightarrow {}^7F_1\right)}$$

SGX	FIR
SGS	4.8
SGP	3.6

$$FIR = \frac{EDT\left({}^4G_{5/2} \rightarrow {}^6H_{9/2}\right)}{MDT\left({}^4G_{5/2} \rightarrow {}^6H_{5/2}\right)}$$

SGX	FIR
SGS	1.45
SGP	1.45

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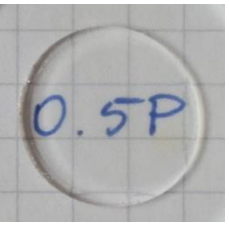
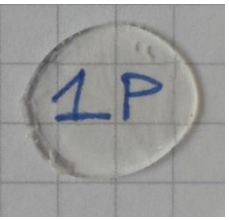
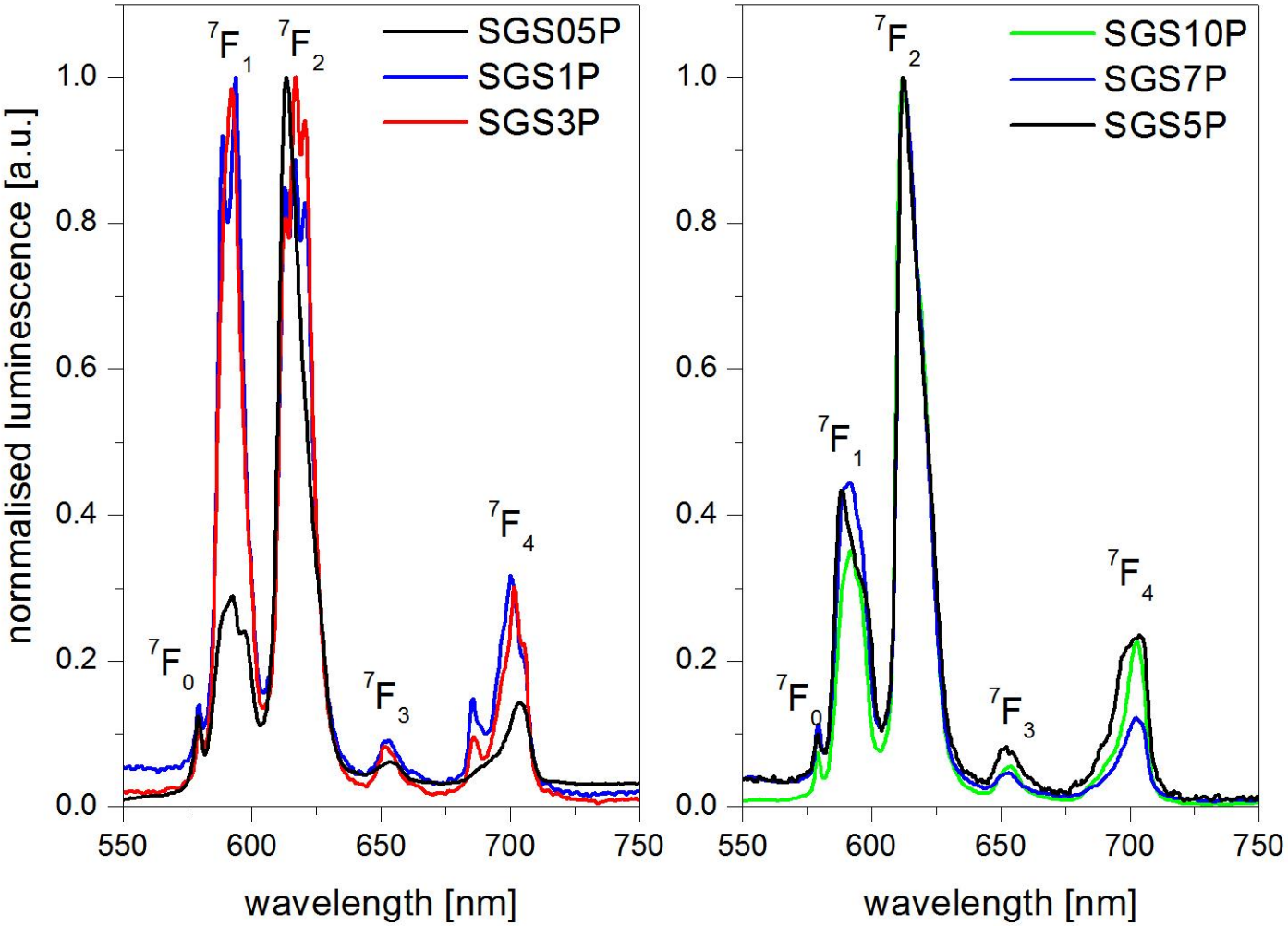
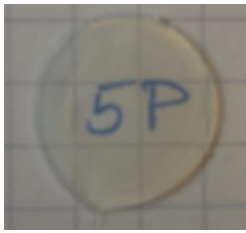
Modification of RED antimony-germanate glasses by P_2O_5 in terms of glass-ceramics fabrication

SGX glass - ceramics: Sb_2O_3 - GeO_2 - (50-x)SiO_2 - xP_2O_5- Eu_2O_3



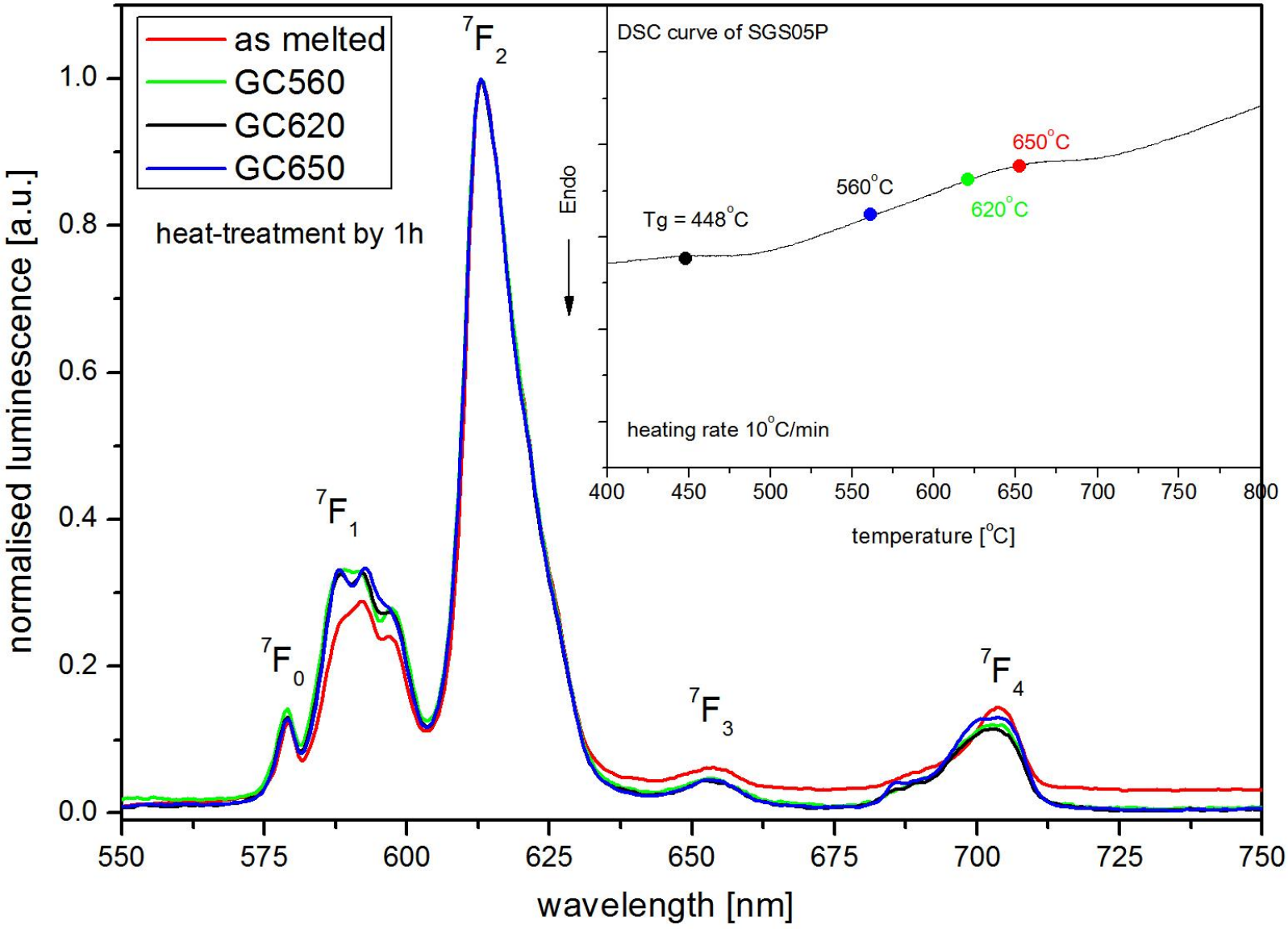




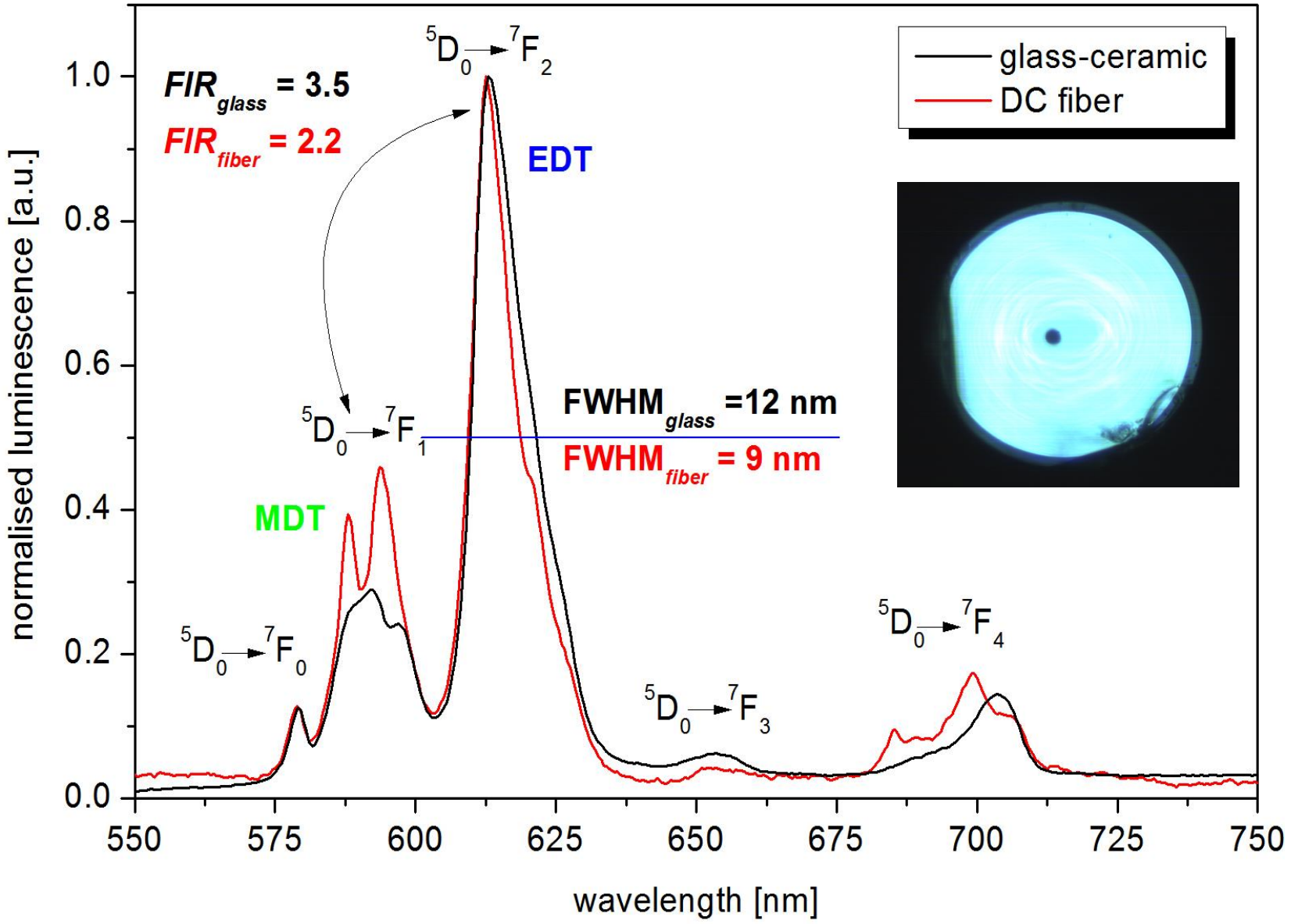


Glass with **0.5P2O5** has lowest tendency to fast crystallisation

SGX glass - ceramics: 0.5 Eu_2O_3



SGX glass–ceramic optical fiber : $0.5Eu_2O_3$



Summary

Conclusions:

- Developement of antimony-germanate glasses characterised by **high thermal stability** - required in optical fiber fabrication!
- **Optimisation** of glass composition towards controlable ceramization process.
- Fabrication of **double-clad** optical glasses with local symmetry in **RED antimony-germanate** core .

Perspectives:

- Investigation of the relations between optical properties of glass ceramics and optical fibers – collaboration.
- Special glass-ceramics double-clad optical fibers enable to construct of highly efficeint visible fiber source for medical and life sciences

ACKNOWNLEGMENTS

The research activities were performed by:

- **National Science Centre (Poland)** *„New antimony glasses with mixed low, high – phonon energy for the construction of active optical fibers”* **No. DEC-2012/07/B/ST8/04019,** (2013-2016).
- ***National Science Centre (Poland)*** *„Mechanisms influencing differences in luminescent properties of glasses and optical fibers doped with lanthanides”* ***No. DEC-2013/09/D/ST8/03987*** (2014-2017).
- **CNR-PAS joint project** *“Nanostructured systems in opal configuration for the development of photonic devices”* (2014-2016).
- **The COST Action MP1401** *“Advanced fibre laser and coherent source as tools for society, manufacturing and life science”.*

Action MP1401

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Thank You For Your Attention