# On the optical properties of Ge-Ga-S-CsCl chalcogenide glasses


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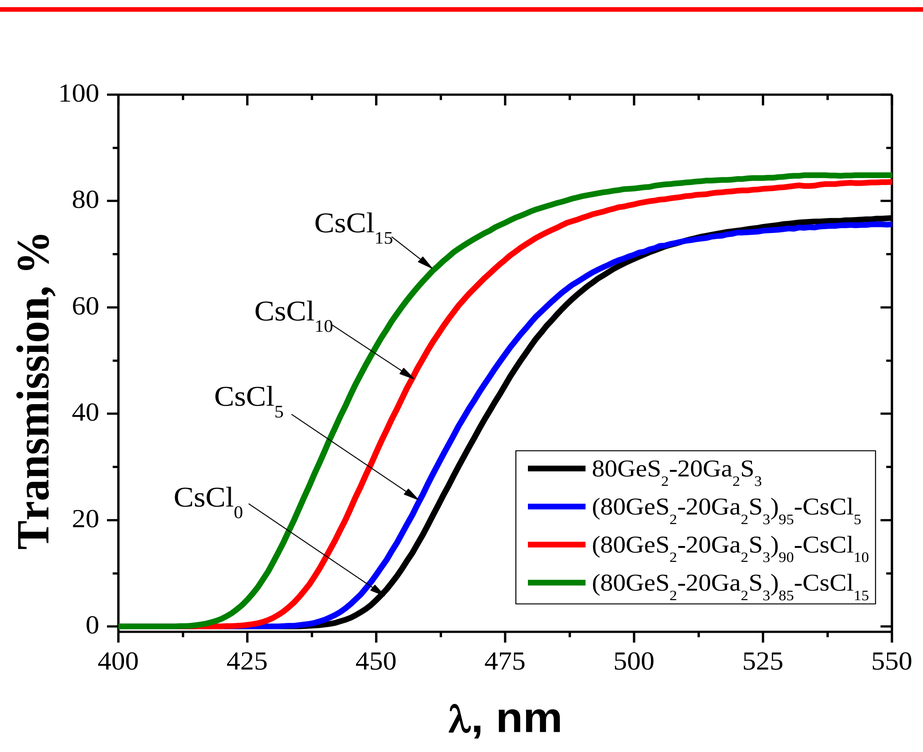
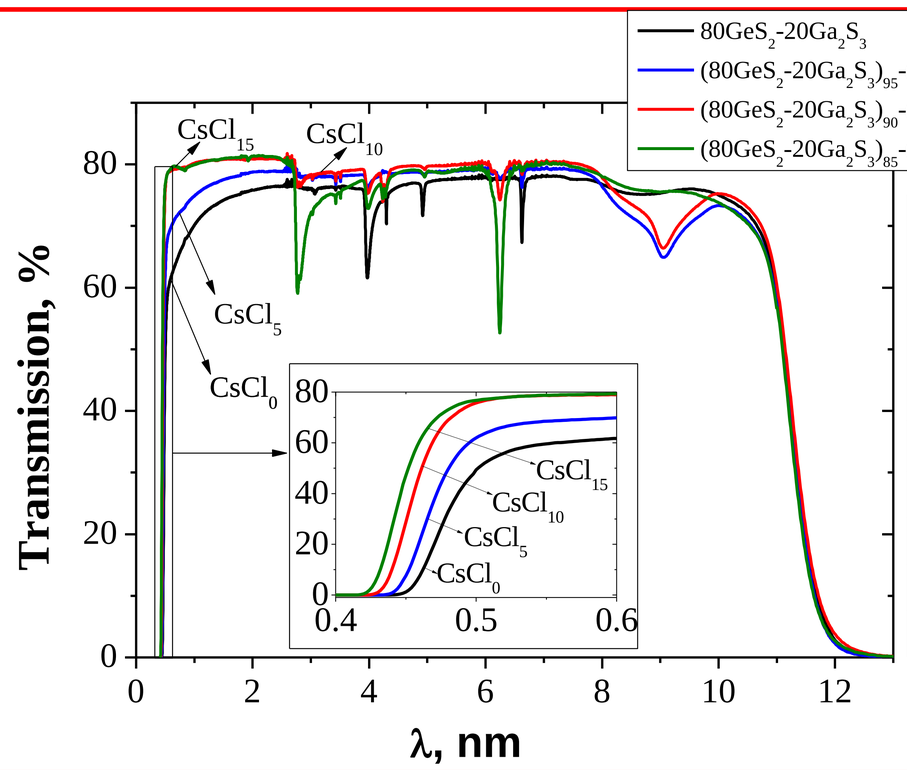
**Chalcogenide glasses (ChG) based on Ge-Ga-S have shown many advantages for potential applications of optical modulator, efficient laser host materials, fiber-optical amplifier in the IR region. Addition of CsCl to ChG matrix result in improvement of their mechanical properties and changes optical properties.**

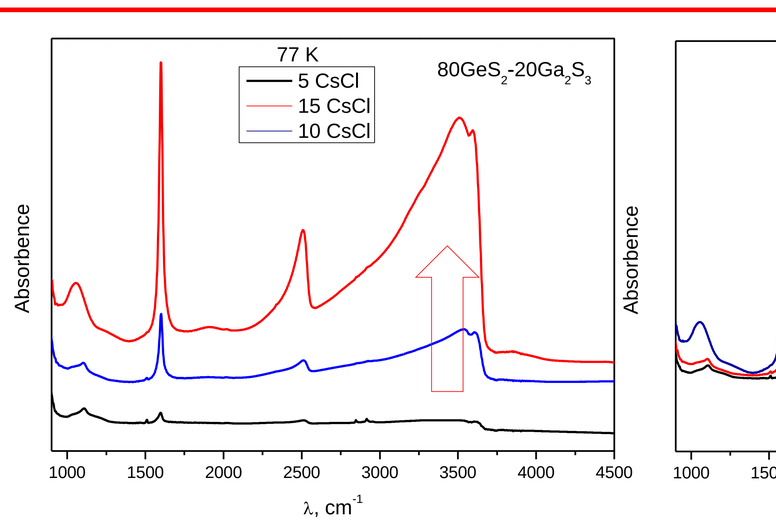



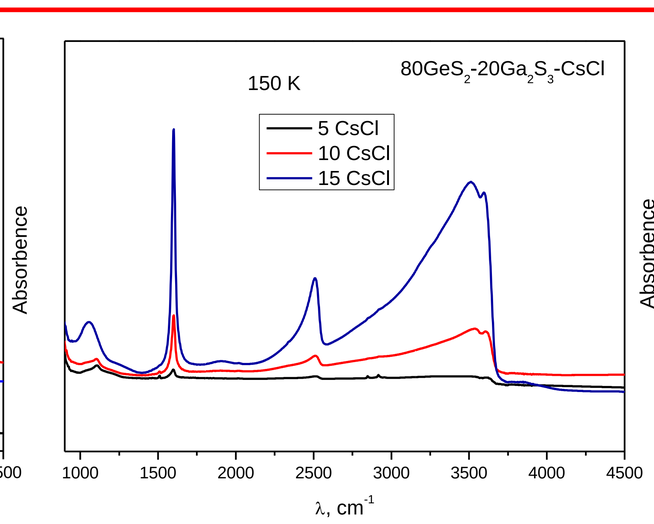



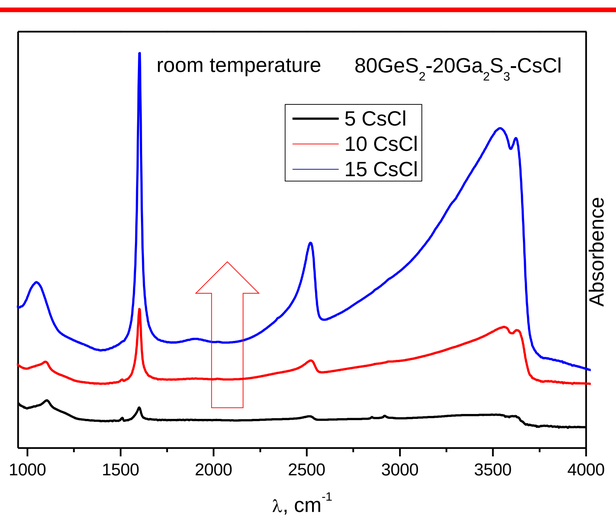

**Position of absorption band maxima observed in the transmission spectra of the Ge-Ga-S-CsCl glasses**

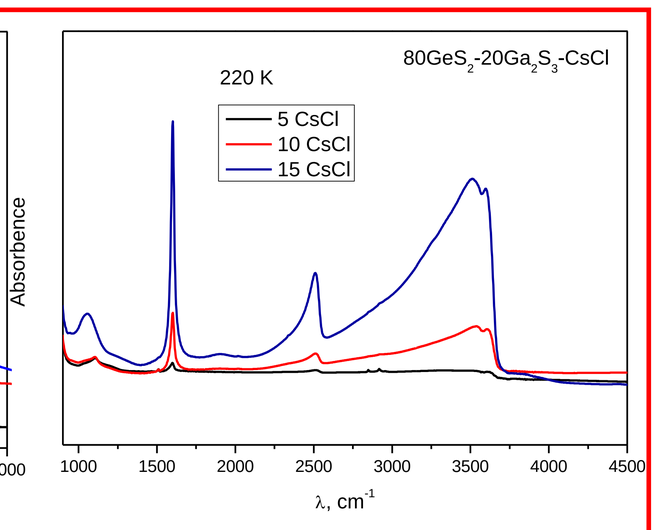
| | |
|---|---|
| 1.93; 2.79; 6.23 | $H_2O$ |
| 2.79 | $OH^-$ |
| 3.98 | SH |
| 9.01 | Si-O |
| 4.88 | Ge-H |

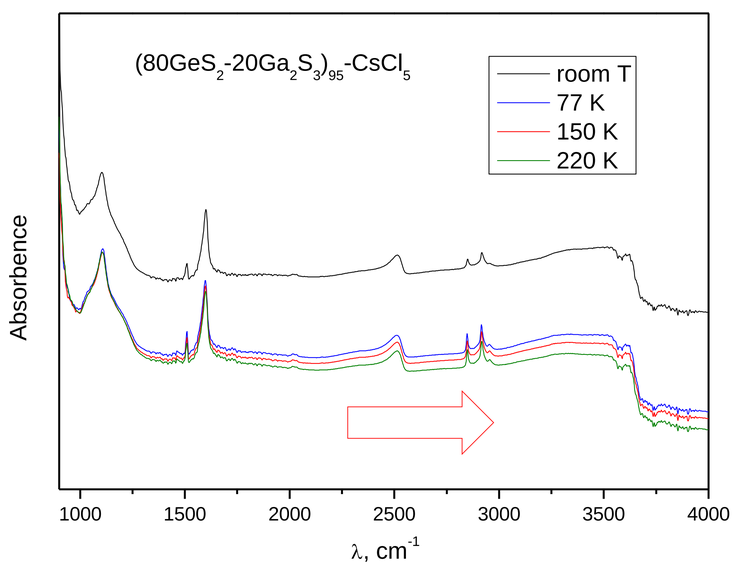
**The optical properties in visible and far-infrared (FIR) regions of ChG belonging to the series $(80GeS2–20Ga2S3)_{100–x}(CsCl)_x$ with x = 0; 5; 10; 15 were investigated. It is shown that the addition of CsCl induces a white shift of the visible transmission. By adding up to 15% mol. of the alkali halide in the glassy matrix, the band-gap evolves from 2.64 eV to 2.91 eV. From a structural point of view, the addition of less than 15 % of CsCl in $GeS_2–Ga_2S_3$ glasses is characterized by the formation of $GaS_{4-x}Cl_x$ tetrahedral that are dispersed in the glass network. In other words, the average number of Ga–S bonds is decreased for the benefit of the average number of Ga–Cl bonds.**

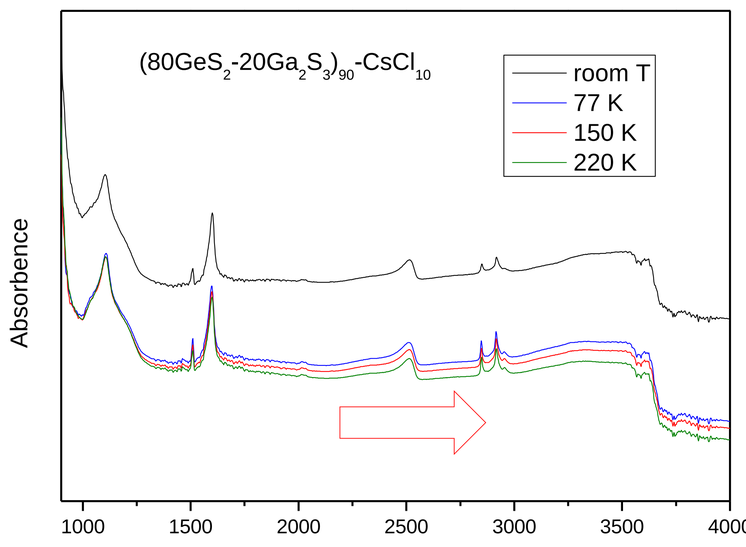


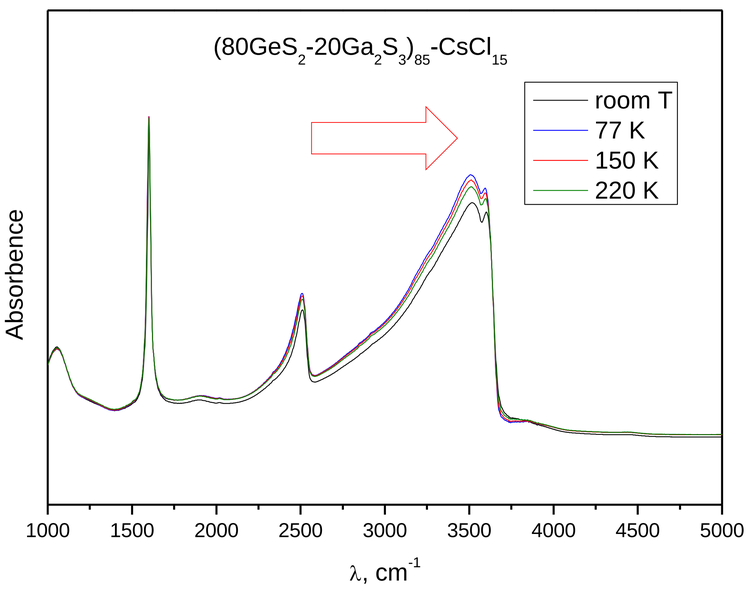



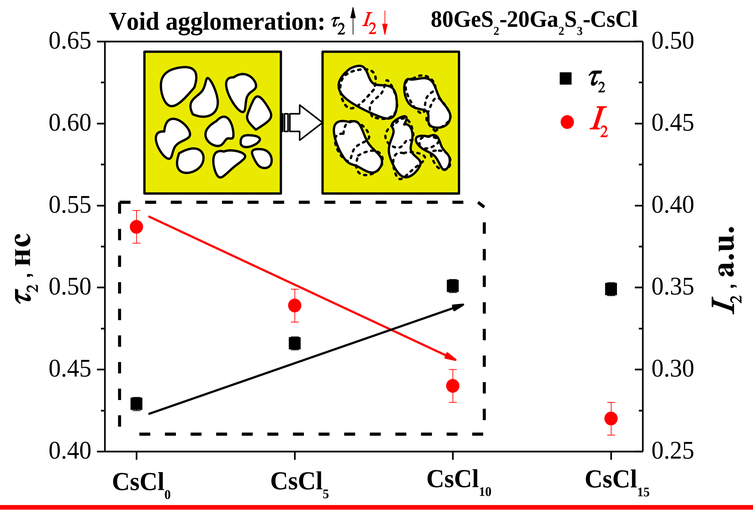




**Influence of temperature on FIR spectrum of Ge-Ga-S-CsCl glasses studied by Fourier Transform Infrared (FTIR) spectroscopy measurements at 77 K, 120 K, 150 K and room temperature.**




## Free volume transformation

| Sample | Fitting parameters | | | |
|---|---|---|---|---|
| | $\tau_1$, ns | $I_1$, a.u. | $\tau_2$, ns | $I_2$, a.u. |
| $80GeS_2$-$20Ga_2S_3$ $CsCl_0$ | 0.201 | 0.62 | 0.429 | 0.38 |
| $(80GeS_2$-$20Ga_2S_3)_{95}CsCl_5$ | 0.233 | 0.66 | 0.466 | 0.34 |
| $(80GeS_2$-$20Ga_2S_3)_{90}CsCl_{10}$ | 0.248 | 0.71 | 0.501 | 0.29 |
| $(80GeS_2$-$20Ga_2S_3)_{85}CsCl_{15}$ | 0.239 | 0.73 | 0.499 | 0.27 |