Erbium Doped GLS for mid-infrared Laser

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ABSTRACT

Gallium Lanthanum Sulphide (GLS) based glasses are proposed as high quality hosts for rare-earth doped, mid-infrared lasers, that would offer compact laser sources for gas sensing, atmospheric transmission, and medical applications. Waveguides were inscribed via the Ultrafast Laser inscription Technique (ULI) in Er^{3+} doped GLS and the mid-infrared transitions at 1.55 and 2.73 µm have been detected and characterized, which opens the potential for realising Er^{3+}GLS mid-IR waveguide lasers.

1.INTRODUCTION

- GLS is a radically new chalcogenide alternative to toxic arsenic-based glasses, with a range of remarkable optical and physical properties such as optical transparency from the visible to infrared extending beyond 8µm low maximum phonon energy and thermal stability up to 550oC.
- GLS glasses posses several advantages over other glass materials as rare-earth hosts. The solubility of rare-earth ions is extremely high due to the presence of lanthanum as a glass former, and the emission cross sections of rare-earth levels are enhanced by the high refractive index (n=2.4). This potentially gives access to MIR transitions for lasers.
- The Ultrafast laser Inscription technique was utilised to fabricate optical waveguides in Er^{3+} doped GLS substrates.
- The waveguides were pumped with a 980nm continuous wave source and the mid-Infrared transitions have been detected and characterized. The mode images and the fluorescence spectra were captured.

2. Er $^{3+}$ Doped Gallium Lanthanum Sulphide (Er^{3+}GLS)

- Er^{3+} doped GLS present a number of mid-Infrared transitions from 1.55 to 4.5µm opening the potential for realising mid-IR lasing sources.

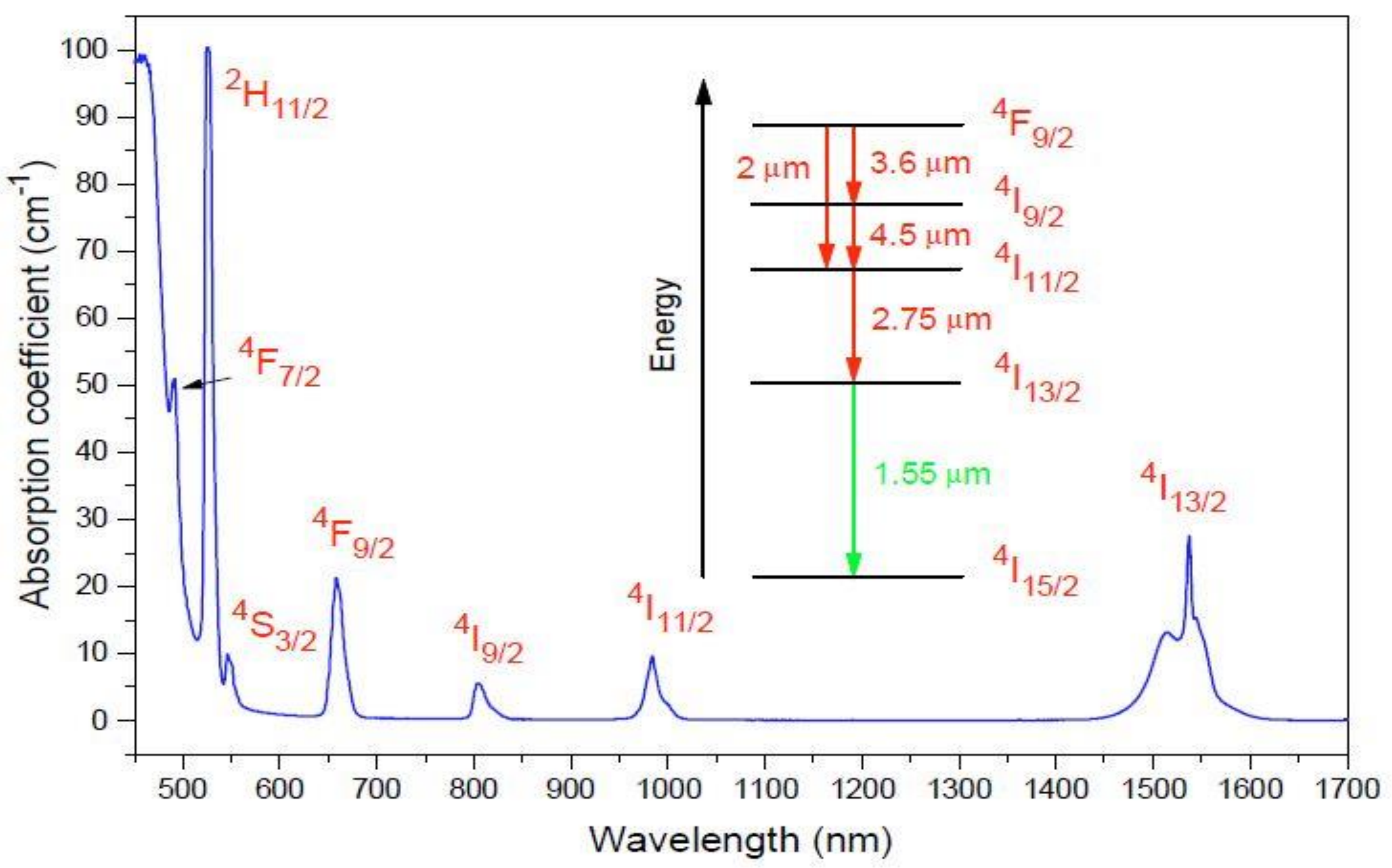

Figure 1. Absorption spectrum of 9.7mol% Er3+ doped GLS glass and Er3+ energy levels indicating the infrared transitions.(Reference 5)

3. ULTRAFAST LASER INSCRIPTION (ULI)

Advantages

- Quick Fabrication
- Fabrication without clean room environment
- Maskless process
- Easily automated through computer control
- 3D Fabrication Capabilities

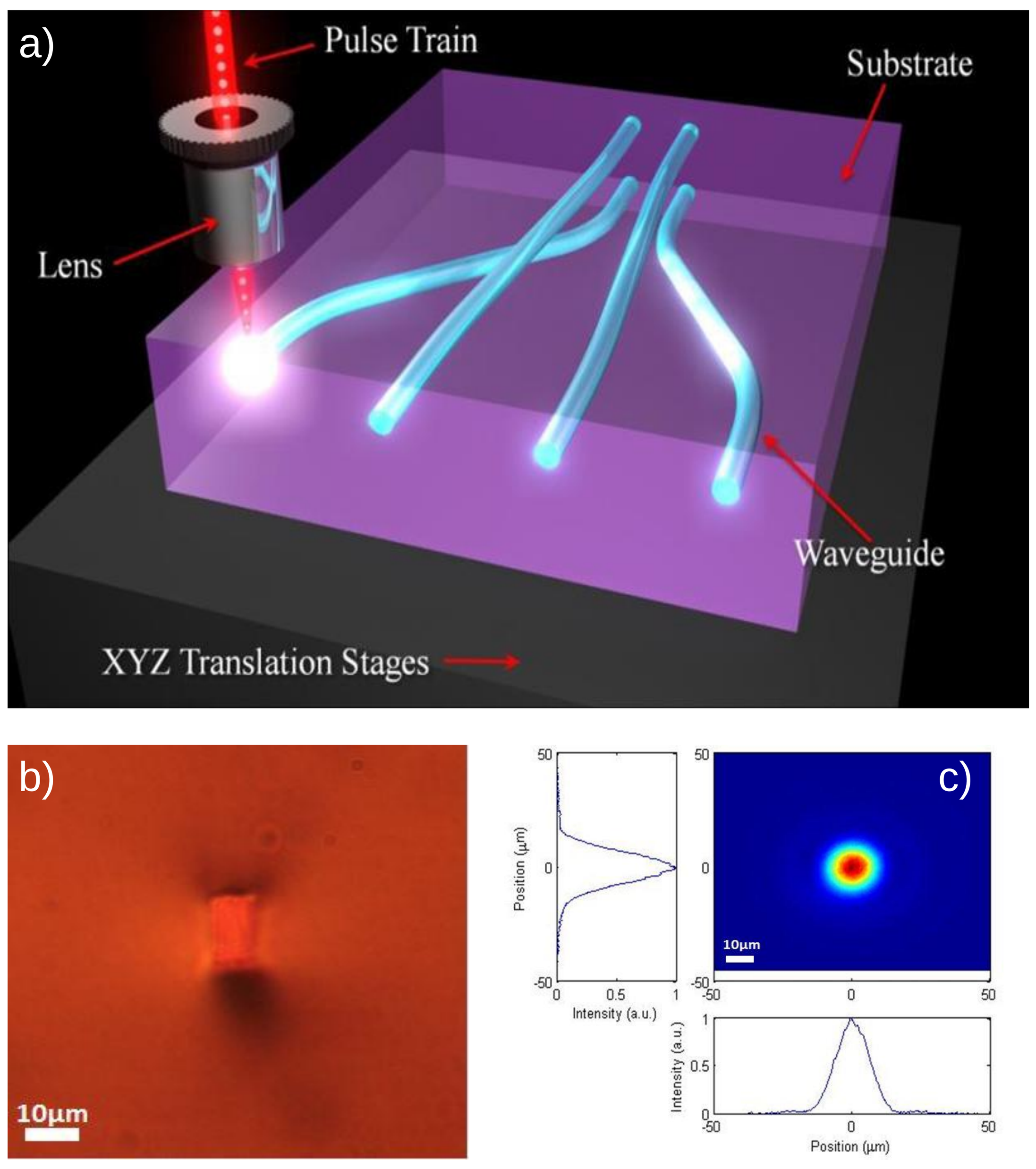

Figure 2. a) Diagram of ULI, b) Waveguide cross section inscribed in 2%Er^{3+} :GLS via ULI, c) respective fluorescence mode at 2,73 µm

4. 1% Er^{3+} doped GLS

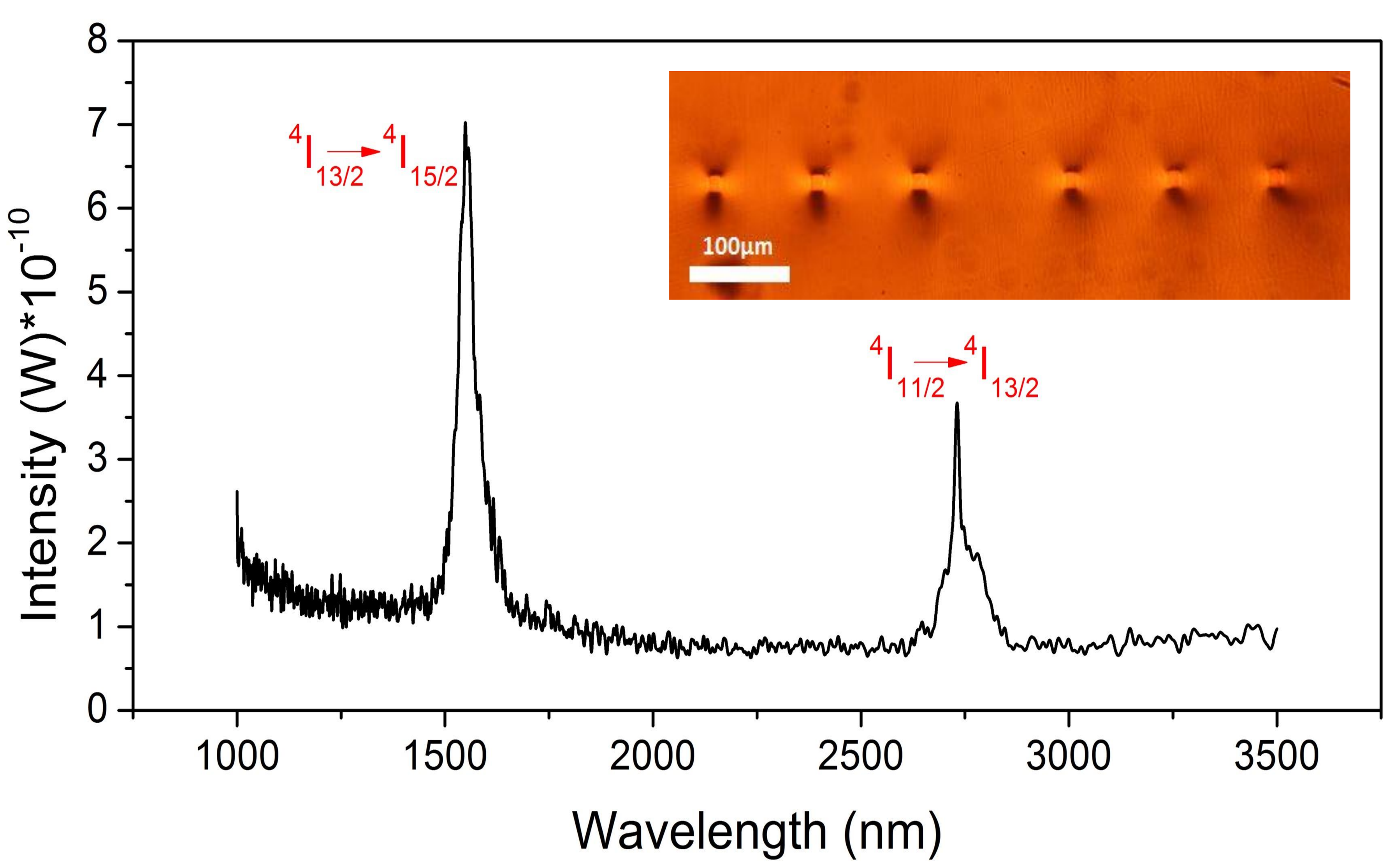

Figure 3. 1.55 µm and 2.73 µm fluorescence spectra for 1%Er^{3+}GLS and waveguide images inscribed in 1%Er^{3+}GLS.

5. 2% Er^{3+} doped GLS

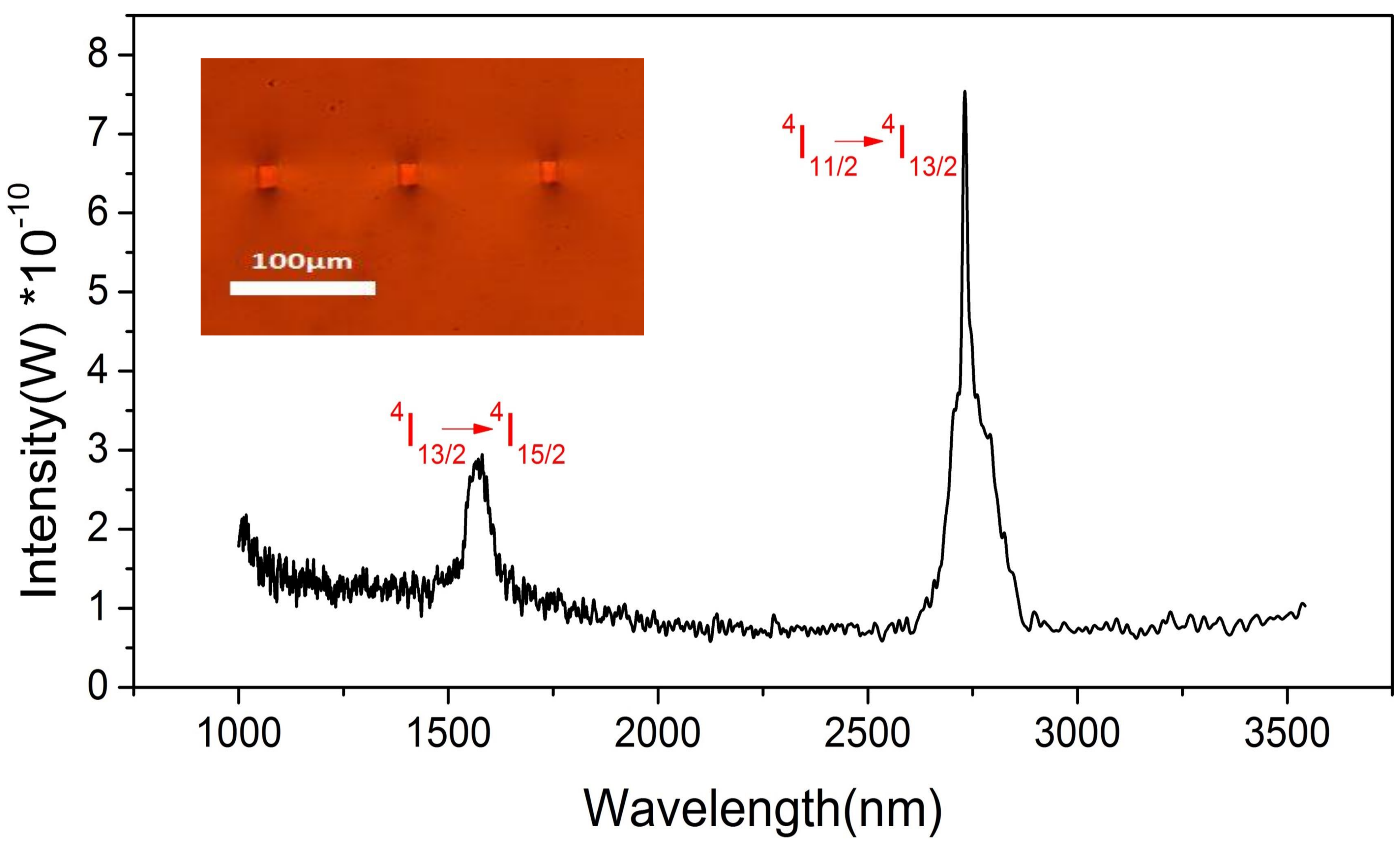

Figure 4. 1.55 µm and 2.73 µm fluorescence spectra for 2%Er^{3+}GLSand waveguide images inscribed in 2%Er^{3+}GLS.

6.CONCLUSION

- Presented the fabrication of Waveguides in Er^{3+}:GLS by utilising the ULI technique.
- Demonstrated fluorescence at 1,55 µm and 2.73 µm in samples with different Er^{3+} concentrations.
- Possibility or realising Er^{3+}:GLS waveguide mid-IR lasers.

7. REFERENCES

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