Development of upconversion glass for true-3D tabletop display

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A volumetric 3D display is one of the more commercially feasible true 3D tabletop display strategies – full colour, full parallax, real-time rendering, and interactivity [1]. This allows for a wide range of applications in air traffic control, medical imaging, automotive and aerospace design, visualisation in weather or defence monitoring. Previous work in this area has examined the use of upconversion in low-phonon-energy ZBLAN fluoride glass, as well as single crystal $NaYF_4$ as the imaging material in static volumetric display systems [2, 3]. However, these glasses and crystals are difficult to produce at a sufficient quality and size for display purposes.

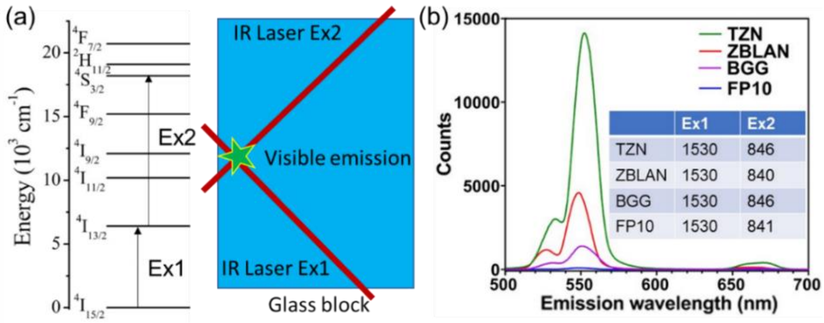

Figure 1: (a) Dual-wavelength upconversion concept for 3D display. (b) Upconversion spectra for various Er^{3+} doped glasses under their corresponding optimum pulsed dual-excitation wavelengths.

In this work, we examined a range of low-phonon-energy glasses that have the potential for large-scale manufacturing. We characterised the glasses in terms of their upconversion performance for a dual-wavelength IR excitation as used for a 3D display (Figure 1a). Four types of glasses doped with 0.5 mol% Er^{3+} were fabricated: tellurite (TZN), germanate (BGG), fluorophosphate (FP10), and fluoride (ZBLAN). Using a tunable laser system, the upconversion intensity of the four glasses at optimal excitation wavelengths was compared. TZN glass showed the strongest upconversion followed by the ZBLAN, BGG and FP10 glasses under pulsed laser excitation (Figure 1b). We will further examine the upconversion intensity for ZBLAN and TZN glasses under CW dual-wavelength laser excitation, and whether TZN can be employed as scalable 3D display imaging chamber material.

[1] H. Ren, L. Ni, H. Li, X. Sang, X. Gao and Q. Wang, *J. Inf. Disp.* **2020,** 28, (1), 75-91.

[2] E. Downing, L. Hesselink, J. Ralston and R. Macfarlane, *Science* **1996,** 273, (5279), 1185-1189.

[3] H. Refai, B. Salahieh and J. Sluss, *Proc. of SPIE* **2010**, 7625, 76251M.