Low-loss Ti:sapphire waveguides fabricated by pulsed laser deposition

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We report the fabrication and characterisation of Ti:sapphire films epitaxially grown on *c*-cut sapphire substrates by pulsed laser deposition (PLD). Deposition conditions have been studied extensively and optimised in order to produce high-performance optical waveguides. In particular we have studied the effects of different values of oxygen pressure, background gases and substrate temperature on the resultant surface roughness, composition, crystallinity, fluorescence and waveguide losses. For instance we found that Ti:sapphire films deposited in Ar feature higher fluorescence than those grown in O_2 and N_2 (see Figure 1) under the same deposition conditions: laser fluence $F \approx 3.3$ J/cm^2, laser repetition rate $f = 20$ Hz, substrate temperature $T \approx 1050$°C, gas pressure $P \approx 2 \cdot 10^{-3}$ mbar, target-substrate distance $d = 4$ cm.

From our samples we have measured broad fluorescence spectra similar to bulk Ti:sapphire (see inset in Figure 1) and average waveguide losses lower than 1 dB/cm, which is less than the minimum value (~1.6 dB/cm) reported so far in literature [1].

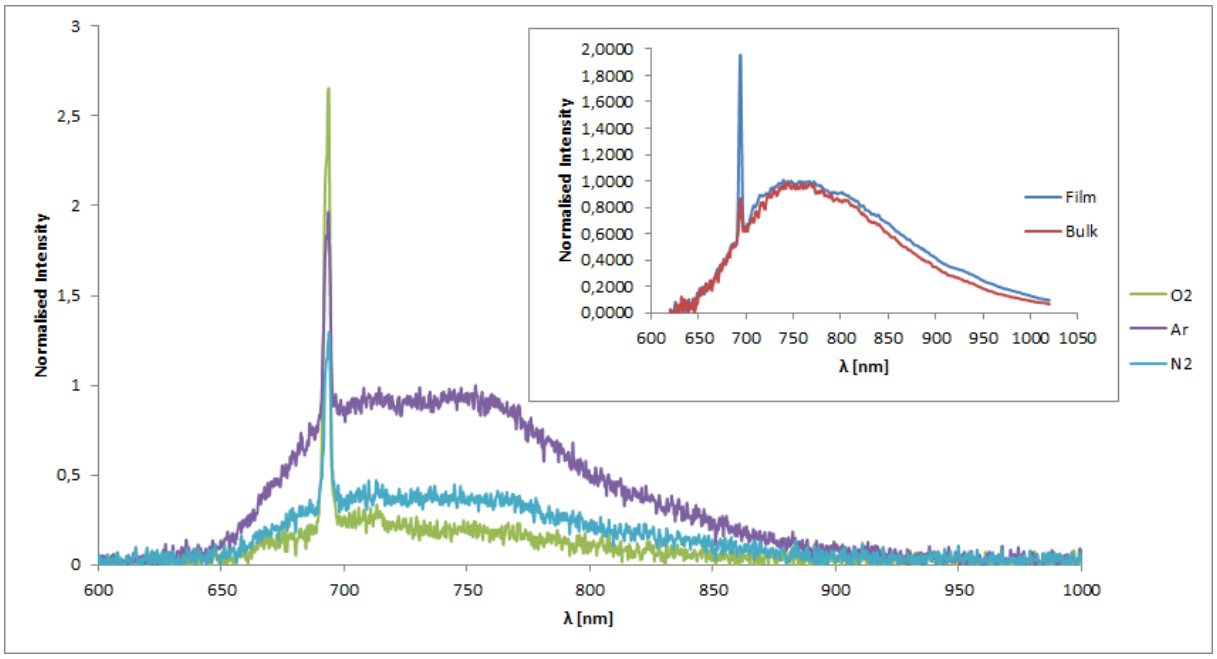

Fig. 1 Fluorescence spectra from 3 Ti:sapphire films deposited with oxygen (O_2), argon (Ar) and nitrogen (N_2). The inset shows fluorescence spectra from bulk Ti:sapphire and one of our samples, deposited in vacuum (P = 10^{-4} mbar). The spike at ~694 nm is due to Cr^{3+} impurities.

Future plans include lasing experiments both in continuous wave and pulsed mode with an Ar^+ pump laser and we hope to be able to report these results soon. These experiments will also give a more accurate confirmation of waveguide losses measured by optical transmission.

Given the markedly reduced waveguide loss results, we expect our samples to have a correspondingly improved performance than previously reported in literature [2, 3], in terms of output power and lasing slope efficiency.

References

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