Waveguiding and Crystallographic Properties Of Single Crystal Ti:Sapphire Layers Produced by Pulsed Laser Deposition.

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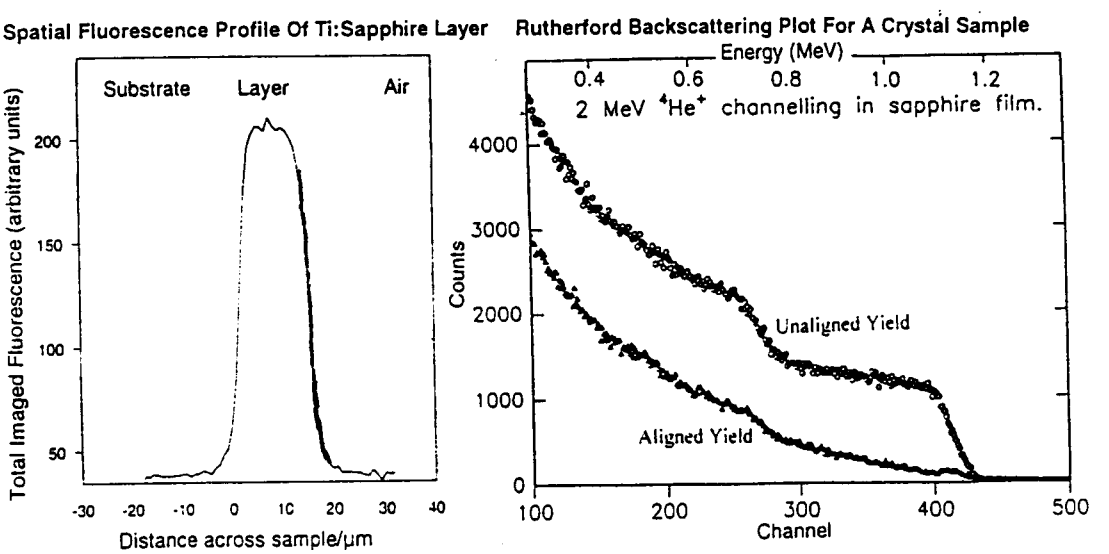
Layers of Ti:Sapphire with thicknesses between 1 and 82 microns have been produced by the Pulsed Laser Deposition (PLD) of a bulk Ti:Sapphire target (0.1 wt. %) onto nominally pure sapphire substrates of (0001) orientation .These were grown in ambient oxygen at around 10^{-4}mbar using a KrF excimer laser supplying 500mJ per pulse, resulting in an energy density of 3-4 J/cm^2.

Layers deposited over the range 1300K to 1700K are found to be crystalline, as grown, to a degree which compares favourably with bulk sapphire and films fabricated by post annealing amorphous alumina layers [1].This was determined using X-ray analysis (Powder Diffractometer and Texture Camera) and Ion Beam Channelling. Films deposited below this range are amorphous or poly-crystalline and multi-phase.

Proton Induced X-Ray Excitation (PIXE) and Inductively Coupled Plasma Mass Spectrometry (IC-PMS) reveal that the proportion of Titanium incorporation into the crystalline films decreases with the deposition temperature. Those at the upper extreme showing Ti levels similar to the nominally un-doped substrates.

Films of the order of 10 microns exhibit waveguiding without any additional co-doping required to raise the layer index. The inherent waveguide losses in these films were measured by end launching at 633nm (using a HeNe laser since this wavelength lies outside the Ti absorption band) and were found to be in the range 1dB/cm to 4dB/cm. This suggests that a Ti:Sapphire waveguide laser is feasible by this route.

Further it was found that by side pumping the layer (with the argon ion 488nm line) and imaging the end face that, in general, the spatial distribution of the fluorescence closely resembles the 'top hat' function that would be indicative of an even concentration of Ti^{3+} throughout the layer, as expected for this method of deposition. Mode profiles have also been obtained.



[1] N. Yu, M. Nastasi , Appl. Phys. Lett **65** , 180 (1994)