Growth of single and multilayer sesquioxide crystal films for lasing applications via pulsed laser deposition

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Sesquioxides, materials of the form RE_2O_3 (RE: rare earth), are of great interest for lasing applications. These materials offer high thermal conductivities, are mechanically stable, can easily be doped with various rare earth ions and are optically isotropic. Members of the sesquioxide family have the same crystal structure but differing refractive indices, and hence are ideal candidates for multilayer as well as single film growth. Sesquioxides can be challenging to grow from the melt, however, due to their high melting points (>2400 ºC).

Pulsed laser deposition (PLD) is a simple and versatile thin film fabrication technique that should be suited to sesquioxide growth, providing the required high growth temperatures (≥900 ºC) can be achieved. We present the growth via PLD of doped and undoped scandia, lutetia and yttria thin films on 10×10 mm^2 c-cut sapphire substrates. An excimer laser ablated ceramic targets in an oxygen gas pressure of 8×10^{-2} mbar. Substrates were heated to ~1000 ºC via CO_2 laser to obtain (222)-orientated crystal films whose thicknesses ranged from ~2 to ~10 µm, with thicker film growth currently under investigation. Particulate densities are low ($<10^4/cm^2$); scattering and hence propagation losses are therefore expected to be much lower than in previous reports [1]. Lutetia and yttria films have also been grown on lutetia and yttria substrates respectively.

Emphasis has been placed on the growth of Yb:lutetia for lasing applications. Single- and cladded multilayer samples will be presented, along with the results of lasing experiments.

[1] Kahn et al, Opt. Express 17(6) (2009)

Sesquioxides are of great interest for lasing applications, but can be difficult to grow from the melt due to their high melting points. We present the growth of doped and undoped scandia, yttria and lutetia films on sapphire substrates via pulsed laser deposition. Substrates were heated to ~1000 ºC to obtain (222)-orientated crystal films many microns in thickness. Particulate densities are low ($<10^4/cm^2$); propagation losses are hence expected to be low. Emphasis has been placed on the growth of Yb:lutetia for lasing applications. Single- and cladded multilayer samples will be presented, along with the results of lasing experiments.