11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Fabrication of luminescent optical quality Aluminosilicate Microtubes

J.E. McCarthy (1), Y.K. Gun'ko (1)

(1) School of Chemistry, Trinity College Dublin, Dublin 2, Ireland

Abstract – Luminescent aluminosilicate microtubes have been fabricated using vacuum infiltration of a sol-gel into microchannel glass membranes. The micro cylinders show high aspect ratio with lengths of 70-100μm and diameters of 8μm or 25μm depending on membrane pore size. The aluminosilicate microtubes display strong luminescence under UV excitation upon annealing at 500°C. This emission is thought to arise from carbon defects in the aluminosilicate matrix. The microtubes also display whispering gallery mode (WGM) resonance when excited with a focused laser spot at the edge of the tube. The tubes are characterised by solid state photoluminescence, optical microscopy and SEM.

Fabrication of optical quality microcavities for applications in optical amplification, microcavity lasing, sensing capabilities and frequency stabilisers. Optical microcavities can extend the lifetime of light at optical frequencies within its interior by setting up whispering galley mode resonances (WGM), the ability of the cavity to operate in this capacity is judged by its quality (Q) factor. Fabrication of the microtubes was achieved via vacuum assisted infiltration of an aluminosilicate sol-gel into microchannel glass membranes. Tetraethoxysilane and aluminium iso-propoxide precursors were used in a ratio of 10:1 Si:Al and hydrolysed using an HCl as a catalyst with water and ethanol. The viscous sol was infiltrated into the microchannel glass and allowed to age in air and then annealed @ 500°C. The microtubes are released via mechanical fracture of the microchannel glass over a suitable substrate. Released microtubes can be seen in figure 1 below.

The tubes are examined under solid state photoluminescence and display a broad intense emission in the visible region. This emission is proposed to have arisen from carbon defects within the aluminosilicate matrix brought by upon annealing, which causes the decomposition of organic species trapped within the pores of the matrix during sol-gel processing as proposed by Green et al [1]. The microtubes also display whispering gallery mode resonance when excited at the edge of the tube by a laser. This WGM effect is displayed below in figure 2 seen as a series of peaks in the emission spectrum of the microtube.

Microtubes have also been fabricated doped with europium which display characteristic emission peaks of trivalent Eu after annealing. The versatility of sol-gel processing opens up a number of doping possibilities allowing for various potential applications of the tubes into photonic systems requiring specific emission characteristics. The WGM resonance displayed opens up the future possibilities in optical storage and sensing applications.

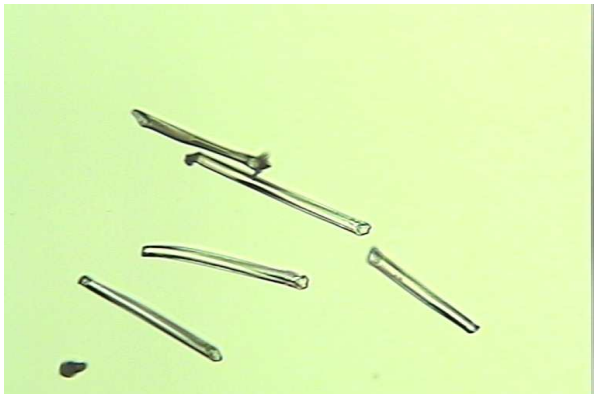

Figure 1: Optical microscope image of Aluminosilicate microtubes

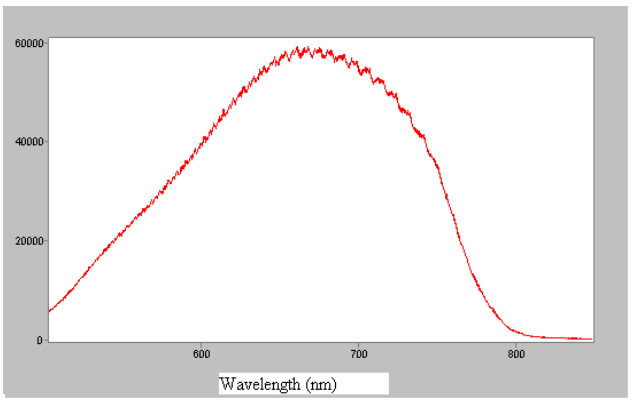

Figure 2: Solid state PL of microtube displaying WGM resonance

References

[1] W. H. Green, K. P. Le, J. Grey, T. T. Au and M. J. Sailor, Science 276 (1997) 1826.