Time-resolved photoluminescence excitation characterisation of lanthanide and group III *tris*(8-hydroxyquinoline) molecules

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Time resolved photoluminescence measurements of a range of lanthanide and group III tris(8-hydroxyquinoline) molecules have been performed as a function of both laser excitation wavelength and temperature. The role of the lanthanide ion on the ligand luminescence will be discussed and compared to that from the group III hydroxyquinoline salts. Measurements of the lifetimes of both the ligand luminescence and the lanthanide emission for all the materials will be presented.

Photoluminescence measurements of the ligand luminescence from different lanthanide tris(8-hydroxyquinoline) molecules show variations in the emission with some molecules exhibiting peaks in the luminescence at ~500nm, which corresponds to the singlet emission as seen in the group III tris(8-hydroxyquinoline) molecules. Whereas other molecules exhibit ligand emission at ~600nm, which is believed to correspond to triplet recombination. We have measured the ligand luminescence from a range of these molecules using different excitation wavelengths from 350nm to 500nm and we have seen that the emission process depends on both the excitation wavelength and temperature. For LnQ, for example, we obtain a room temperature photoluminescence spectra with a single peak at ~500 nm when we excite with 410nm, whereas with excitation at 460nm the photoluminescence peak occurs at ~600nm. For ErQ the 600nm emission dominates the room temperature photoluminescence for all excitation wavelengths although there is a definite feature at ~500nm for the shorter excitation wavelengths which again disappears at excitation wavelengths greater than ~450nm. AlQ by comparison shows very little evidence for the ~600nm emission at room temperature, independent of the excitation wavelength. Whereas at 80K its behaviour becomes more like that of LnQ although not as pronounced.

For photoluminescence measurements from AlQ at 80K we have measured the luminescence lifetime of the 600 nm emission to be ~20ns. For the lanthanide molecules however the corresponding emission have a lifetime of the order of 1ns. These results are consistent with the increased spin-orbit coupling due to the heavier ions decreasing the luminescence lifetime.

Luminescence lifetime measurements of the emission from the lanthanide ions: erbium, neodymium and ytterbium all show effective lifetimes of the order of microseconds which is very fast compared to the lifetimes of the free ions. Using excitation directly into the lanthanide ion (e.g ~980nm excitation for erbium) and via the organic ligands (~400nm excitation) we have seen that there are no changes in the emission lifetimes and hence the exciton transfer from the ligand to the lanthanide ion is not a rate limiting step.