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Using Terbium Phthlamate Containing Electrospun Nanofibers as Ammonia Gas Sensors

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Extended Abstract

Electrospinning is a relatively simple method of producing nanofibrous materials. The process involves applying a large voltage to a viscous solution containing a mixture of an organic polymer along with an active ingredient. The resultant meshes have found application in drug delivery systems, as tissue scaffolds and as sensory materials for a range of analytes primarily due to the large surface to volume ratio of the fibres and the porous nature of the materials. As a consequence toxic gas sensing seems to be ideal application of these materials where diffusion through the mesh and adsorption on to the fibre surface should be rapid.

In addition, there are many well-known examples sensory systems utilizing the strongly emissive lanthanide ions terbium and europium coordinated to chromophoric ligands - the limit of detection of these systems is known to be extremely low (*ca*. 10^{-15} M) so in many ways represent the ultimate set of chemical sensors. Previous work by has yielded terbium-phthalamate complexes with luminescence that is extremely sensitive to pH changes (Chen, 2012).

The aim of this project is combine both these themes to generate and optimize a new generation of ammonia sensors based on porous nanofibrous networks containing terbium-phthalate complexes.

There are many examples of commercially available ammonia sensors however these have relatively high limits of detection (ppm scale). There are numerous chronic diseases related to elevated levels of ammonia gas in exhaled breath including chronic liver disease which is often asymptomatic in its early stages. However low levels ammonia gas in breath (ppb scale) can only be detected with relatively sophisticated instruments and as such, this has limited the commercialisation of these for point-of-care applications. (Hibbard, 2012) It is visualized that a device based on a blend of luminescent lanthanide complexes with a suitable electrospun organic polymer could provide a highly sensitive solution to this problem and to the best of our knowledge there are currently no other examples of this type of material reported in the literature. This presentation will describe our early finding from this project including measured ammonia detection limits and full characterisation of the materials.

References

Chen G, Sarris J, Wardle N, Bligh A, Chatterton N, "A chemically unlocked binary molecular switch", Chem. Comm., 2012, 48, 9026-9028.

Hibbard T, Killard A, "Breath ammonia analysis: Clinical application and measurement", Crit. Rev. Anal. Chem., 2011, 41, 21-35