

## Phthalocyanines

Phthalocyanines are highly coloured compounds which have found widespread commercial application. Recently phthalocyanines have been developed as photosensitising agents for PDT.

The pyrrole groups in phthalocyanines are conjugated to benzene rings and bridged by aza nitrogens rather than methine carbons. This causes the absorption spectrum to shift to longer wavelengths and the Q bands to become more intense than the Soret peak. The shift of this red absorption peak permits the use of longer wavelength light with increased tissue penetration to excite these compounds (typically around 680 nm), compared with the 630 nm light used to excite porphyrins.

A long-life triplet state is required for efficient photosensitisation and this criterion may be fulfilled by the incorporation of a diamagnetic metal such as Zn or Al into the phthalocyanine macrocycle. Metal-free compounds and phthalocyanines containing paramagnetic metals such as Cu, Co and Fe have a much shorter triplet lifetime and display minimal phototoxicity.

Phthalocyanines are generally hydrophobic compounds although water-soluble derivatives can be readily synthesised through substitution of the ring with moieties such as sulphonic acid, carboxylic acid and amino groups. The sulphonated compounds, and in particular chloro aluminium sulphonated phthalocyanine (ALPcS) have received the most attention with regard to photodynamic efficacy. Purification of these derivatives can be a problem and the final product is typically a mixture of mono- di- tri- and tetrasulphonated derivatives. Furthermore, these compounds have been observed to aggregate at relatively low concentrations in aqueous media which results in loss of photochemical activity.

ALPcS exhibits selective retention in some tumours. This coupled with negligible dark-toxicity, minimal cutaneous photosensitivity, and excellent photodynamic activity at increased wavelengths has led to the clinical evaluation of ALPcS for PDT.