Two-Photon Absorption Cross-Section of Chalcone-Based Porphyrin Derivatives Towards Therapeutical Purposes

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Porphyrins are a unique family of molecules with diverse applications, including in photovoltaic cells, sensors, and therapeutic treatments. One notable application is photodynamic therapy (PDT), used to treat certain cancers and microbial infections. PDT works by generating singlet oxygen upon light irradiation, leading to the selective destruction of harmful cells. A crucial feature of effective PDT photosensitizers, such as porphyrins, is a high triplet quantum yield, enabling efficient singlet oxygen production. Despite this, improving light penetration into tissues remains a challenge, as the linear absorption wavelength range does not cover any biological window. To address this, nonlinear optical properties, particularly two-photon absorption (TPA), are highly desirable. TPA can enhance photosensitizer effectiveness by increasing light penetration depth in tissues [1].

This study investigates the two-photon absorption properties of tetraphenylporphyrin derivatives containing chalcone ligands, aiming to enhance their effectiveness as photosensitizers in PDT. The aimed property is the two-photon absorption cross section, which can be obtained through an indirect method consisting of measuring the fluorescence response following two-photon excitation. It uses a femtosecond pulsed laser and an Optical Parametric Amplifier, allowing for a wide excitation wavelength range. A well-characterized molecule, free-based tetraphenylporphyrin (TPP), serves as a reference for each measurement [2] by the indirect relation

$$\sigma_s = \frac{F_s}{F_{ref}} \times \frac{C_{ref}}{C_s} \times \frac{\phi_{ref}}{\phi_s} \times \sigma_{ref}.$$

The results showed a few of the cross-sections of the chalcone-ligand tetraphenylporphyrins exceeded those of TPP due to their increased molecular asymmetry, thus enhancing their potential as effective PDT photosensitizers.

References

[1] P A Shaw, E Forsyth, F Haseeb, S Yang, Mark Bradley and M Klausen, Front. Chem. **10**, 921354 (2022)

[2] M Drobizhev, Ny S Makarov, S E Tillo, T E Hughes and A Rebane, Nat. Methods **8**, 393 (2011)