

Retrieving the fluorescence quantum yield using a controlled photonic environment

Jord.C. Prangsma, Linda Meijer, Vinod Subramaniam and Christian Blum
NanoBioPhysics Group, University Twente
Postbus 217, 7500AE Enschede
j.c.prangsma@utwente.nl

Fluorescent probes such as fluorescent proteins, quantum dots or organic molecules are of great interest as labels for imaging in cells. A parameter of central importance to these applications is the quantum yield of the fluorophores. However, conventional methods to determine this parameter are biased by the presence of absorbing but non-emitting states.

An alternative method, that does not have this drawback, makes use of a controlled modification of the photonic environment to obtain the radiative and non-radiative rates. In this method the fluorescent probe is placed in several environments that have well known optical properties while pertaining identical chemical environments. In this way the radiative rate of the fluorophore can be changed controllably, while its non-radiative rate is kept constant. By measuring the fluorescent lifetime and thus the total decay rate of the dyes in the different optical environments both the radiative and non-radiative rates can be extracted.

Current approaches following this method position the fluorophores at controlled nanometer scale distances to a metallic mirror. These approaches however, rely on time consuming and expensive fabrication techniques to achieve accurate control over the density of optical states [1,2]. We explore the use of a very simple method that uses a curved mirror that can be placed on a sample to achieve the required density of states control.

Our method relies on the fabrication of small tripods consisting of three 100 μm large Polystyrene beads coated with a thick reflective gold layer. These can be placed on top of spin coated layers of dye. Lifetime changes of up to 40 % are observed enabling accurate determination of the quantum yield.

- [1] Y. Cesa et al. *Physical Chemistry Chemical Physics* 11 (14), pp. 2525-2531 (2009).
- [2] A. Kwadrin et al. *J. Phys. Chem. C* 116, 16666–16673 (2012).