

Oxazine and rhodamine confined into nanosized latex particles. A successful strategy to increase the energy transfer efficiency and to develop improved red-edge emitting dyes.

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Abstract

The development of tunable dye lasers working in the red part of the visible or the near infrared (>650 nm) is a very active area of research due to the advantages, which offer these devices in many fields; such as, biomedicine or biophotonic. For instance, the long wavelength light can penetrate deeper into tissues. However, most of the red dyes reported in the bibliography have two main drawbacks: low absorption at the standard pump wavelength and poor photostability. One approach to overcome these problems is to excite the red-emitting dye from a donor dye, characterized by high photostability, via a non-radiative Förster resonance energy transfer (FRET). Such mechanism requires good overlap between donor emission and acceptor absorption bands and depends strongly on the distance between donor and acceptor molecules, which usually demands high concentrations. One way to ensure the proximity of the dye molecules and ameliorate the efficiency of the energy transfer process is enclosing the donor and acceptor molecules within solid host of nanometric size (Figure 1).¹

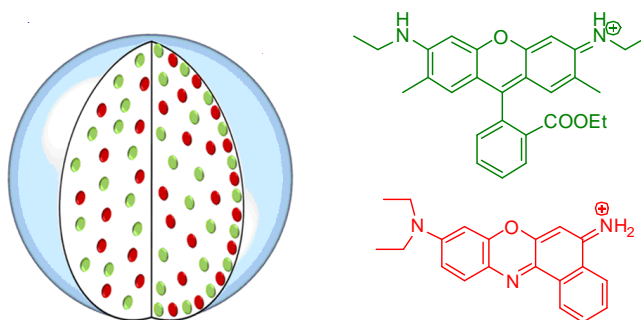


Figure 1. Rhodamine G and Nile Blue encapsulation into latex nanoparticles.

Recently, we confirmed that the photophysical and lasing properties Rhodamine 6G (Rh6G) confined into polymeric nanoparticles (latexes) and homogeneously dispersed in aqueous suspensions are further enhanced.² On the basis of these promising results, we decided to use this system for the FRET device. To this aim, we chosen Nile Blue (NB) as energy acceptor since its spectra overlap with the energy donor rhodamine is high enough to ensure improved energy transfer efficiencies (Figure 1).

The absorption spectra confirm the presence of the two chromophores into the latex framework, without signs of aggregation, regardless of the dye-loading of the nanoparticles. The fluorescence and excitation spectra confirm the presence of the FRET process (Figure 2). Indeed, bright red-emission

from the NB is detected upon excitation of the donor rhodamine. Accordingly, the fluorescence from the xanthene is quenched by the FRET process, as is reflected in the faster fluorescence decay in the donor region.³ Compared with donor/acceptor physical mixtures in solutions, with the same Rh6G and NB proportions used in the latex measurements, the FRET efficiency is greatly ameliorated owing to the dye encapsulation, which imply closer donor-acceptor distances. The energy migration enables that the FRET process happens at longer distances. As result, efficient and photostable laser emission is recorded for the NB, pumping at the Rh6G.

Work in progress is carried to modulate the FRET efficiency by changing the donor/acceptor ratio or the size of the nanoparticle.

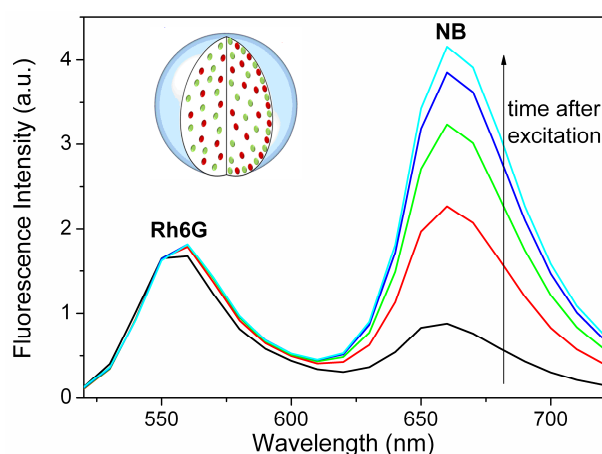


Figure 2. Fluorescence emission at different times after excitation upon excitation at the Rh6G in aqueous suspensions of latex doped with Rh6G and NB.

References

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