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Thursday, December 14, 2023 – 11.00 a.m. U5 - Seminar room – 1st floor

IR and UV-emitting persistent luminescence nano-agents for bioapplications

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Persistent luminescence (PERL) materials have the unique property of continuing to emit light for an extended period after excitation has ceased. While the 1990s saw the development of efficient green-emitting bulk PERL materials such as $SrAl_2O_4$:Eu,Dy, our challenge during the 2010s has been to design and synthesize PERL materials **in the form of nanoparticles that emit in the red/NIR range.** **$ZnGa_2O_4:Cr^{3+}$** [1] nanoparticles, prepared by a hydrothermal method, have proven to be outstanding as in vivo small animal autofluorescencefree imaging probes [2] and have revealed an original persistent luminescence mechanism based on localized charge trapping around Cr^{3+} doping ions [3].

However, combining high PERL efficiency and nanoparticle size remains challenging with classical soft chemistry methods. Therefore, we are now developing an original synthesis way based on **Mesoporous Silica Nanoparticles (MSN)-templated nanocasting,** to synthesize PERL nanophosphors with controlled morphology and mesostructure. The mesoporous nano-platforms permit an easy coupling of PERL material like $ZnGa_2O_4:Cr^{3+}$ with an organic photosensitizer (and/or other drugs) to perform photodynamic therapy (PDT) against deep-seated tumors [4].

On the other hand, we are also developing **UV-emitting PERL nanoparticles** as nano-triggers for bioorthogonal photoclick. Only recently has there been an increase in interest in UV-emitting bulk PERL materials for targeting applications such as optical tagging, photocatalysis, and sterilization [5]. Materials, such as germanates, are all prepared by solid-state chemistry and no NPs have yet been reported. We are therefore preparing **YPO_4:Ce,Ho nanoparticles** as UV-C PERL emitters to be used as nano-triggers for bioorthogonal
photoclick control.

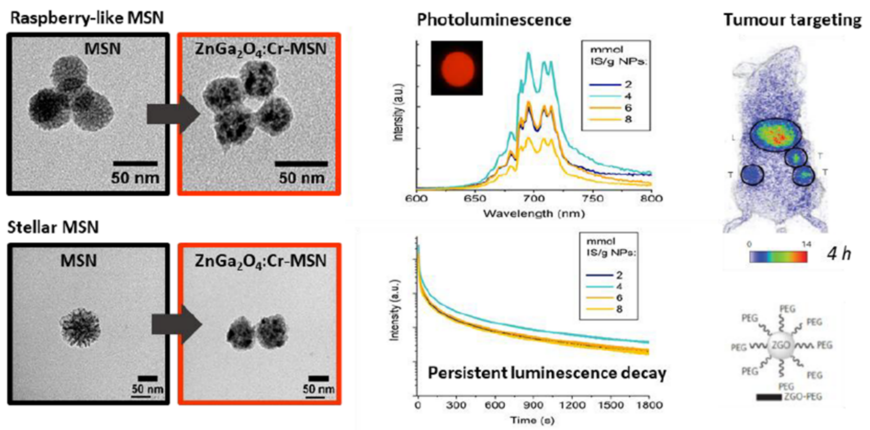

Figure 1: mesoporous silica nanoparticles (MSN) templated $ZnGa_2O_4:Cr^{3+}$: TEM, photoluminescence, persistent luminescence decay. Passive tumour targeting by PEGylated $ZnGa_2O_4:Cr^{3+}$ nanoparticles.

References

1. Bessiere, A., et al., Optics Express, 2011, 19(11): p. 10131-10137.
2. Maldiney, T., et al., Nature Materials, 2014. 13(4): p. 418-426.
3. Bessiere, A., et al., Chemistry of Materials, 2014. 26(3): p. 1365-1373.
4. Bessière, A., J.-O. Durand, and C. Noûs, Nanophotonics, 2021.
5. Wang, X. and Y. Mao, Advanced Optical Materials, 2022: p. 2201466