# Hybrid plasmonic nano-emitters: on the interest of controlling the spatial distribution of the active medium

**Minyu Chen[1,2], Dandan Ge[1], Ali Issa[1], Safi Jradi[1], Christophe Couteau[1], Oliver Soppera[3], Ludovic Douillard[4], Céline Fiorini[4], Aurélie Broussier[1], Sylvie Marguet[5], Renaud Bachelot [1,2,6]**

1. University of Technology of Troyes/L2n, EMR CNRS 7004, Troyes, France
2. Sino-European School of Technology, Shanghai University, Shanghai, People's Republic of China
3. University of Haute Alsace, CNRS, IS2M UMR 7361, Mulhouse, France
4. University of Paris-Saclay/CEA, CNRS, SPEC, Gif sur Yvette, France
5. University of Paris-Saclay/CEA, CNRS, NIMBE, Gif sur Yvette, France
6. University of Paris-Saclay/LuMin, UMR CNRS 9024, Palaiseau, France
E-mail: renaud.bachelot@utt.fr

In microscale optoelectronics, the possibility to precisely control the spatial distribution of the active medium leads to optimization of systems and devices. At the nanoscale, this issue still constitutes a challenge, especially within the frame of hybrid plasmonic nano-emitters based on coupling between quantum emitters and metal nanocavities [1].

We studied and exploited the controlled nanoscale spatial positioning of semiconductor quantum emitters in the close vicinity of metal nanostructures. This control relies on plasmon-assisted nano-polymerization [2,3] of a photosensitive formulation that hosts nano-emitters [4,5]. In addition to offering a promising platform for nanochemistry, this approach enables the design of the symmetry of the medium surrounding plasmonic nano-antenna.

Through selected examples, it is shown that this approach has opened many new avenues and concepts, such as

- Polarization-sensitive photoluminescence [6] (see Fig. 1 as an illustration)
- Polarization-driven color selection [3]
- Life time engineering [7]
- Rationalized plasmon-assisted donor-acceptor energy transfer
- Single photon switch that is driven by polarization [6]

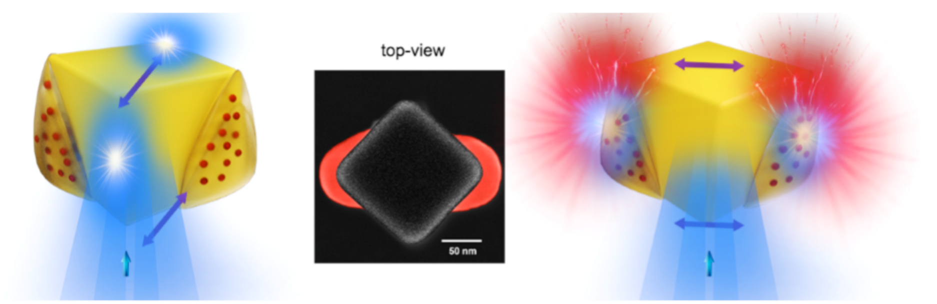


**Fig. 1** Example of hybrid plasmonic nano-source made of a gold nanocube and two polymer lobes containing quantum dots. Left: system shined with an incident polarization perpendicular to the lobes (emitter off). Middle: colored top-view SEM image of the hybrid nano-system. Right: system shined with an incident polarization parallel to the lobes (emitter on).

## References

[1] Gonçalves, P. A. D et al. 2020. *Nat. Commun*., 11, 366.
[2] Ibn El Ahrach, H. et al. 2007. *Phys. Rev. Lett.*, 98, 107402.
[3] Zhou, X et al. 2015. *Nano Lett.,* 15, 7458.
[4] Ritacco, T. et al. 2021. *ACS Appl. Nano Mater*., 4, 6916.
[5] Issa, A. et al. 2021. *ACS Appl. Mater. Interfaces*, 13, 41846.
[6] Ge, D. et al. 2020. *Nat. Commun.,* 11, 3414.
[7] Ge, D. et al. 2022. *Photon. Res*., 10, 1552.