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Functional Interfaces by Colloidal Self-Assembly

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Thus far, controlling these radiation properties was only possible over small areas and at a high expense, including the risks of material degradation. Using a soft lithographic printing method, we can reliably fabricate plasmonic or semiconducting nanocrystals from solution over large areas. This simple fabrication method enables plasmonic or light-emitting metasurfaces to characterize their spectroscopic properties [1] (Figure). Among other applications, we demonstrate the 13-fold amplified directional radiation with an angle-resolved Fourier spectroscopy, which is the highest observed amplification factor for the perovskite-based metasurfaces [2]. Our self-assembly process allows for the scalable fabrication of gratings with predefined periodicities and tunable optical properties. We analyze our approach with numerical modelling, considering the physiochemical properties to obtain the desired geometry. This strategy makes the tunable radiative properties of such nanocrystal-based metasurfaces usable for nonlinear light-emitting devices and directional light sources [3].

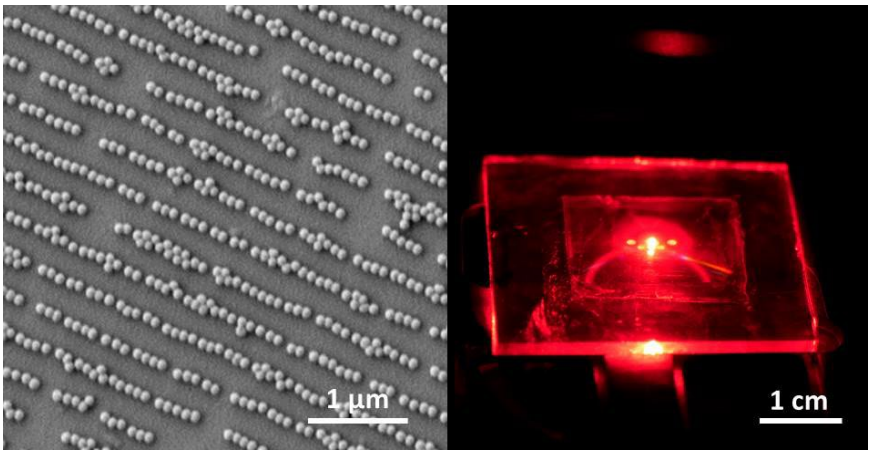

Figure: Soft lithography-based confinement self-assembly of plasmonic or semiconductive building blocks enables nanostructures over centimeter-scale areas. A precise match of the manufactured resonator geometry with our numerical rational design yields in nanostructures with low optical losses.

References

[1] Gupta, V., Sarkar, S., Aftenieva, O., Tsuda, T., Kumar, L., Schletz, D., Schultz J, Kiriy, A., Fery, A., Vogel N. & König, T. A. F. (2021). Nanoimprint Lithography Facilitated Plasmonic-Photonic Coupling for Enhanced Photoconductivity and Photocatalysis. *Advanced Functional Materials*, *31*(36), 2105054.

[2] Aftenieva, O., Brunner, J., Adnan, M., Sarkar, S., Fery, A., Vaynzof, Y., & König, T. A. F. (2023). Directional Amplified Photoluminescence through Large-Area Perovskite-Based Metasurfaces. *ACS nano*.

[3] Aftenieva, O., Sudzius, M., Prudnikau, A., Adnan, M., Sarkar, S., Lesnyak, V., Leo, K., Fery, A. & König, T. A. F. Lasing by Template-Assisted Self-Assembled Quantum Dots. *Advanced Optical Materials*, 2202226.