Laser-assisted processes on metal halide perovskite nanocrystals: Shape/dimensionality transformations and conjugation with 2D materials

K. Brintakis[a,*], A. Kostopoulou[a], E. Stratakis[a,b]

[a] *Institute of Electronic Structure and Laser, Foundation for Research and Technology - Hellas, Heraklion, 71110, Crete, Greece*

[b] *Physics Department, University of Crete, Heraklion, 710 03 Crete, Greece*

Photonic processes such as photothermal, photochemical or photophysical were implemented in colloids in order to fabricate nanocrystals of different morphologies or to modify the size or morphological features of pre-formed nanocrystals. Besides the plethora of reports on laser-based fabrication or size/structure modification of nanocrystals of different -materials, only a few works referred to metal halide perovskite nanocrystals. The limited results have led to poor knowledge/understanding on the interactions of the laser irradiated photon with these materials in these dimensions. These limited works concern the pulsed laser fragmentation in liquid environment, starting from material in powder to form nanocrystals or the alteration of the nanocrystal stoichiometry via an anion exchange with the halides originated from the solvent (dihalomethane). [1,2]

Till now, different morphologies and structures of metal halide perovskite nanocrystals have been synthesized by tuning the parameters of the chemical synthesis such as ratio between the precursors, the time of the reaction, the quantity of the ligands and the temperature of the synthesis. In order to obtain nanocrystals of different morphologies for comparing their properties or application performance, different syntheses have to be carried out, which is a time- and chemicals consuming process. Here we report on a simple and rapid photo-induced method to modify the shape and the dimensionality of metal halide nanocrystals via ultrashort-pulsed laser irradiation of their colloids. [3] Furthermore, conjugations of metal halide nanocrystals with 2D materials could be obtained by similar photo-triggered method. [4]

This rapid and single-step room temperature method provides unique opportunities for the cost-effective fabrication of single- or multi-phase nanostructures with controllable size, shape, and dimensionality. The transformation from one to another nanostructure and the conjugation of two distinct material allows new fundamental studies on the impact of dimensionality and morphology to the final physical properties as well as to new synergetic effects.

References

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* kbrin@iesl.forth.gr