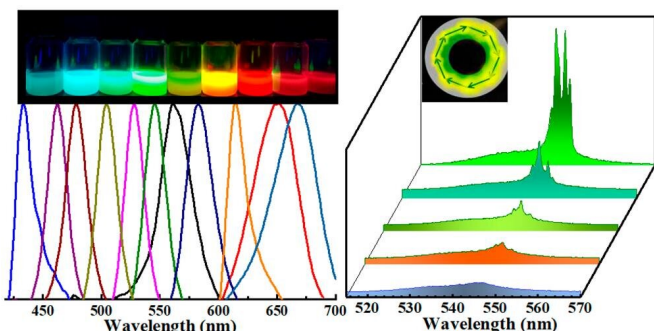


Researchers realize two-photon pumped nanolaser from formamidinium perovskites

14 February 2020, by Zhang Nannan



Tunable photoluminescence and lasing spectra from FAPbX₃ NCs. Credit: SIOM

Formamidinium (FA) perovskites have exhibited outstanding optoelectronic properties in efficient solar cells and light-emitting diodes. However, their development on nanolaser application has rarely been explored, especially the up-conversion lasing performance.

Recently, a collaborative research team from Shanghai Institute of Optics and Fine Mechanics (SIOM) of the Chinese Academy of Sciences (CAS) and Chongqing University has succeeded in obtaining two-photon pumped lasing from colloidal FA-perovskite nanocrystals (NCs) at [room temperature](#). This work was published in *ACS Photonics*.

In the experiment, researcher prepared the FA-perovskite NCs as gain medium by a simple ligand-assisted reprecipitation strategy. These colloidal FAPbX₃ NCs exhibited tunable bright emission (from 433 to 667 nm) through halide exchange.

Simultaneously, by tuning the ratio of the surface organic ligands, the morphology of FAPbBr₃ NCs could be transferred from [quantum dots](#) to nanoplatelets, and consequently, the emission spectra were also tuned in 520-542 nm.

Subsequently, they demonstrated the excellent nonlinear characteristic of NCs. A large two-photon absorption coefficient (0.76 cm/GW) and high optical net gain (480 cm⁻¹) were achieved, suggesting that FAPbX₃ NCs could be regarded as an excellent optical gain medium.

Furthermore, the low-threshold amplified [spontaneous emission](#) (ASE) under both two- and one-photon excitations was observed. The temperature-dependent ASE action revealed the strong temperature-tolerant ASE action with a high characteristic temperature of 308 K, indicating the weak requirements of heat management of FA-based devices.

Finally, FAPbBr₃ NCs were coupled into a hollow capillary tube. Stable two-photon excited whispering-gallery-mode lasing was successfully achieved with a low threshold of $\sim 310 \text{ J/cm}^2$.

These findings suggest that FAPbX₃ NCs can act as promising gain media for high-performance upconverted nanolasers toward optoelectronic application.

More information: Zhengzheng Liu et al. Two-Photon Pumped Amplified Spontaneous Emission and Lasing from Formamidinium Lead Bromine Nanocrystals, *ACS Photonics* (2019). DOI: [10.1021/acsp Photonics.9b01226](https://doi.org/10.1021/acsp Photonics.9b01226)

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