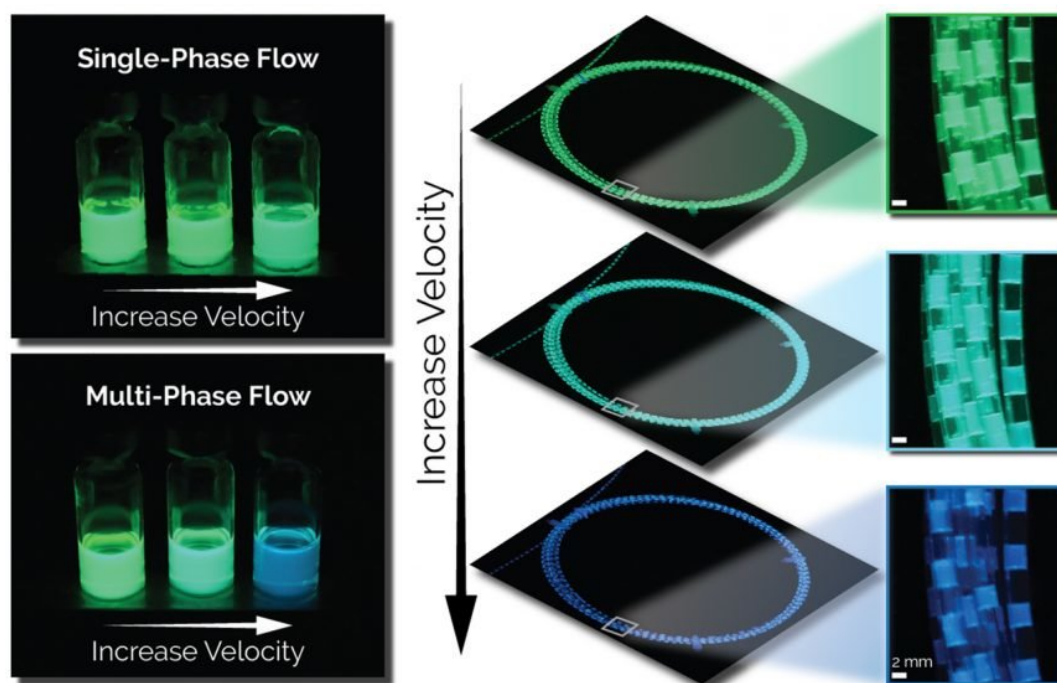


Technology increases microfluidic research data output 100-fold

November 7 2017, by Milad Abolhasani



Effect of controlling mixing time by changing flow velocity on the emission wavelength (i.e., fluorescence color) of the resulting perovskite quantum dots. Credit: North Carolina State University

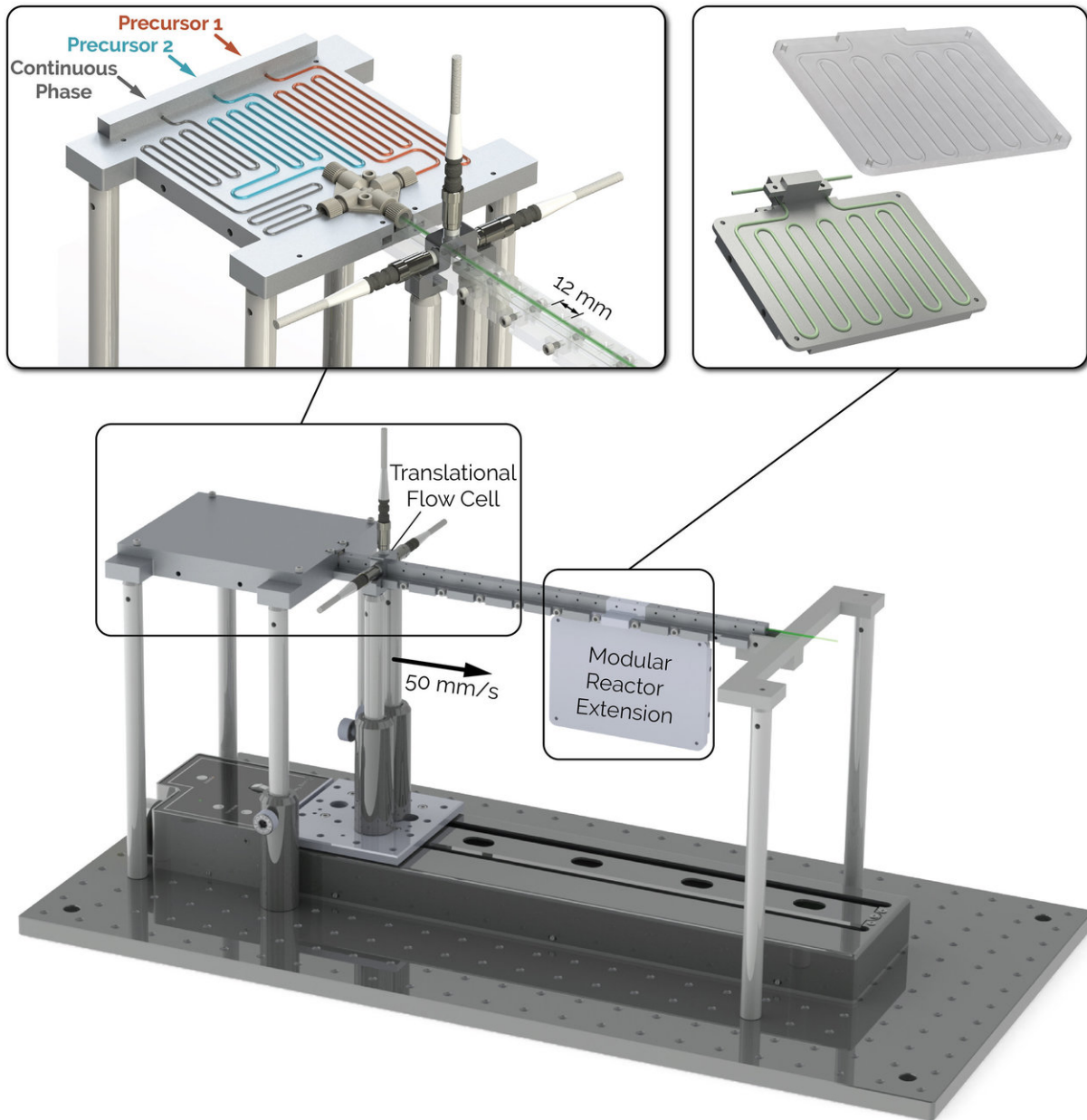
Researchers have developed a technique that allows users to collect 100 times more spectrographic information per day from microfluidic devices, as compared to the previous industry standard. The novel technology has already led to a new discovery: the speed of mixing

ingredients for quantum dots used in LEDs changes the color of light they emit – even when all other variables are identical.

"Semiconductor nanocrystals are important structures used in a variety of applications, ranging from LED displays to solar cells. But producing nanocrystalline structures using chemical synthesis is tricky, because what works well on a small scale can't be directly scaled up – the physics don't work," says Milad Abolhasani, an assistant professor of chemical and biomolecular engineering at North Carolina State University and corresponding author of a paper on the work.

"This challenge has led to an interest in continuous nanomanufacturing approaches that rely on precisely controlled [microfluidic](#)-based synthesis," Abolhasani says. "But testing all of the relevant variables to find the best combination for manufacturing a given structure takes an extremely long time due to the limitations of the existing monitoring technologies – so we decided to build a completely new platform."

Currently, microfluidic monitoring technologies are fixed in place, and monitor either absorption or fluorescence. Fluorescence data tells you what the crystal's emission bandgap is – or what color of light it emits – which is important for LED applications. Absorption data tells you the crystal's size and concentration, which is relevant for all applications, as well as its absorption bandgap – which is important for solar cell applications.



The exploded view of NanoRobo, highlighting the heating and reactor extension modules. Credit: North Carolina State University

To monitor both fluorescence and absorption you'd need two separate monitoring points. And, being fixed in place, people would speed up or

slow down the flow rate in the microfluidic channel to control the reaction time of the chemical synthesis: the faster the flow rate, the less reaction time a sample has before it hits the monitoring point. Working around the clock, this approach would allow a lab to collect about 300 data samples in 24 hours.

Abolhasani and his team developed an automated microfluidic technology called NanoRobo, in which a spectrographic monitoring module that collects both fluorescent and absorption data can move along the microfluidic channel, collecting data along the way. The system is capable of collecting 30,000 data samples in 24 hours – expediting the discovery, screening, and optimization of colloidal [semiconductor nanocrystals](#), such as perovskite [quantum dots](#), by two orders of magnitude.

And, because of the translational capability of the novel monitoring module, the system can study reaction time by moving along the microfluidic channel, rather than changing the flow rate – which, the researchers discovered, makes a big difference.

Because NanoRobo allowed researchers to monitor [reaction time](#) and [flow rate](#) as separate variables for the first time, Abolhasani was the first to note that the velocity of the samples in the microfluidic channel affected the size and emission color of the resulting nanocrystals. Even if all the ingredients were the same, and all of the other conditions were identical, samples that moved – and mixed – at a faster rate produced smaller nanocrystals. And that affects the color of light those crystals emit.

"This is just one more way to tune the emission wavelength of perovskite nanocrystals for use in LED devices," Abolhasani says.

NC State has filed a provisional patent covering NanoRobo and is open

to exploring potential market applications for the technology.

The paper, "Automated microfluidic platform for systematic studies of colloidal perovskite nanocrystals: towards continuous nano-manufacturing," is published in the journal *Lab on a Chip*.

More information: Robert W. Epps et al. Automated microfluidic platform for systematic studies of colloidal perovskite nanocrystals: towards continuous nano-manufacturing, *Lab Chip* (2017). [DOI: 10.1039/C7LC00884H](https://doi.org/10.1039/C7LC00884H)

Provided by North Carolina State University

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