Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Alexandra Ros

Bahige Abdallah

Contact

Shen Yan
shen.yan@skysonginnovations.com

Microfluidic Crystallization Array based on Gradient Mixing

Standard diffusion-based crystallization methods are slow and difficult to quantitate, making them extremely ineffective. Initial materials for crystallization are prohibitively expensive, limiting applications such as serial femtosecond crystallography. Researchers around the world have been working on different micro-/nanobatch techniques to simplify and speed up this process. These techniques are still problematic, because crystal growth parameters cannot be directly and effectively controlled. Resulting nanocrystals are difficult to characterize and harvest from their growth environments. Nanocrystal morphology needs to be extremely precise so the crystals will diffract light as they are meant to for applications such as the x-ray free electron laser. The science community needs a method of controlling initial growth conditions of crystals and accurate characterization of crystals post-growth.

Researchers at Arizona State University have discovered a way to isolate samples to increase control over growth conditions and ensure uniform nanocrystal production. With a new microfluidic device, hundreds of small, distinct experiments can be carried out in parallel. The device is comprised of channels and an array of nanowells. Each nanowell is filled, and then sealed such that samples are completely isolated from each other and the surrounding environment. Samples are then allowed to crystalize. The nanowell environments can be maintained for days at a time to give the crystals ample time to reach fully maturity. Since the device is composed of transparent materials, imaging techniques can be performed on the nanowells after crystals have formed to determine uniformity and size. Optimal growth conditions for several different crystals can be determined at once with this high throughput technique.

Potential Applications

- Protein micro-crystallization
- Protein structure elucidation
- High throughput assays can be used to run hundreds of parallel, unique experiments
- Femtosecond Crystallography
- Batch crystallography

Benefits and Advantages

- Lower Costs – Small sample volumes decrease cost of each experiment.
- Efficiency – Multiple (high throughput) samples in controlled environments can be analyzed simultaneously.
- Controlled Variables – Direct control of individual microenvironments to minimize effect of large number of experimental variables.

- Diverse Applications – Can be used in nearly all fields relating to crystallography to screen samples and products.
- Easily Upscaled –Operate in batch mode to test viability of larger scale experiments where required.
- Quality Control – Transparent materials make coupling with powerful detection techniques to characterize nanocrystal quality easy.
- Nanoscale Experimentation – Low sample volumes allow large protein complexes to be analyzed.

For more information about the inventor(s) and their research, please see

Dr. Alexandra Ros' directory webpage