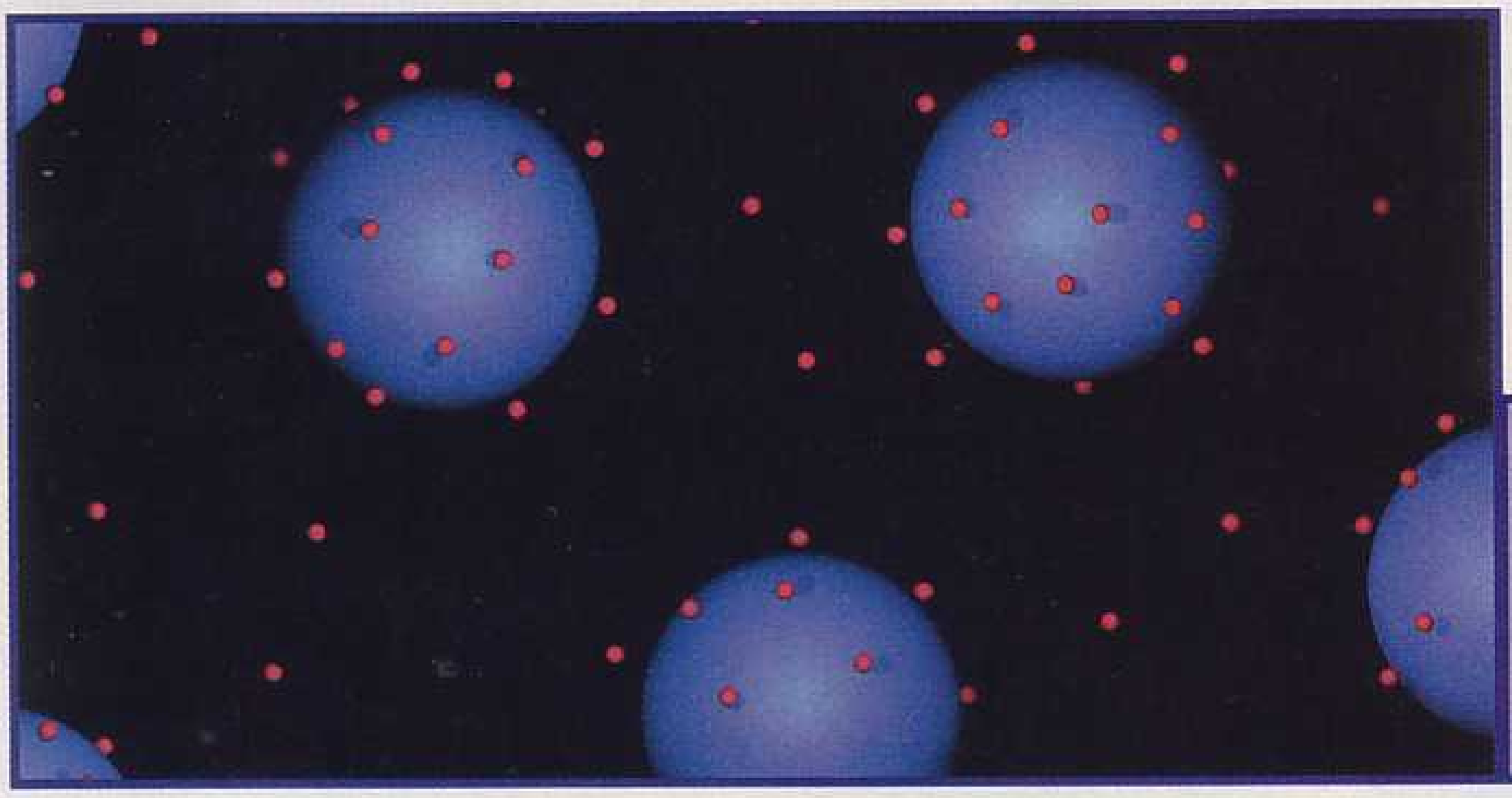
Nanoparticles Stabilize Colloidal Crystals

URBANA, Ill. — Ask those who have tried to produce photonic bandgap materials in the lab with colloidal suspensions, and you're likely to hear about the cracks that appear as the crystals dry. A discovery by a team of researchers at the University of Illinois may go a long way in solving that problem.

When colloidal crystals are grown in an aqueous environment, gaps can form between the particles. As the assembly dries, these spaces collapse and create defects, such as cracks, which affect the desired periodicity. In the July 31 issue of *Proceedings of the National Academy of Sciences*, Jennifer A. Lewis and her colleagues at Illinois and at Carnegie Mellon University in Pittsburgh report a new technique for regulating the stability of colloidal suspensions that may enable engineers to tailor the interactions of colloidal particles.

The process introduces highly charged nanoparticles to a mixture of larger, uncharged particles. In



The self-organizing process known as nanoparticle haloing creates stabler colloidal systems. Charged nanoparticles (red) added to the solution envelop larger, uncharged particles (blue) and control their spacing. Courtesy of Jennifer A. Lewis.

solution, the nanoparticles repel one another and arrange themselves in a halolike configuration around the uncharged ones. This self-organizing process imparts stability to the larger particles, which would attract one another by van der Waals forces under normal conditions.

The process, which the researchers call nanoparticle haloing, offers the ability to tune the separation of these particles and therefore to create either more or less rigid structures. Theoretically, this makes it possible to custom-design a colloidal crystal that can better handle thermal and capillary forces.

Lewis and her Illinois colleague Paul V. Braun have begun proof-of-concept work. They are assembling the structures on patterned substrates via colloidal epitaxy, a technique pioneered by one of their collaborators, Pierre Wiltzius of Lucent Technologies Inc.'s Bell Labs in Murray Hill, N.J.

Index of refraction for photonics

The next step will be to experiment with different microspheres and nanoparticles to realize the desired combination. They also hope to identify nanoparticles with the required index of refraction for applications in photonics. □

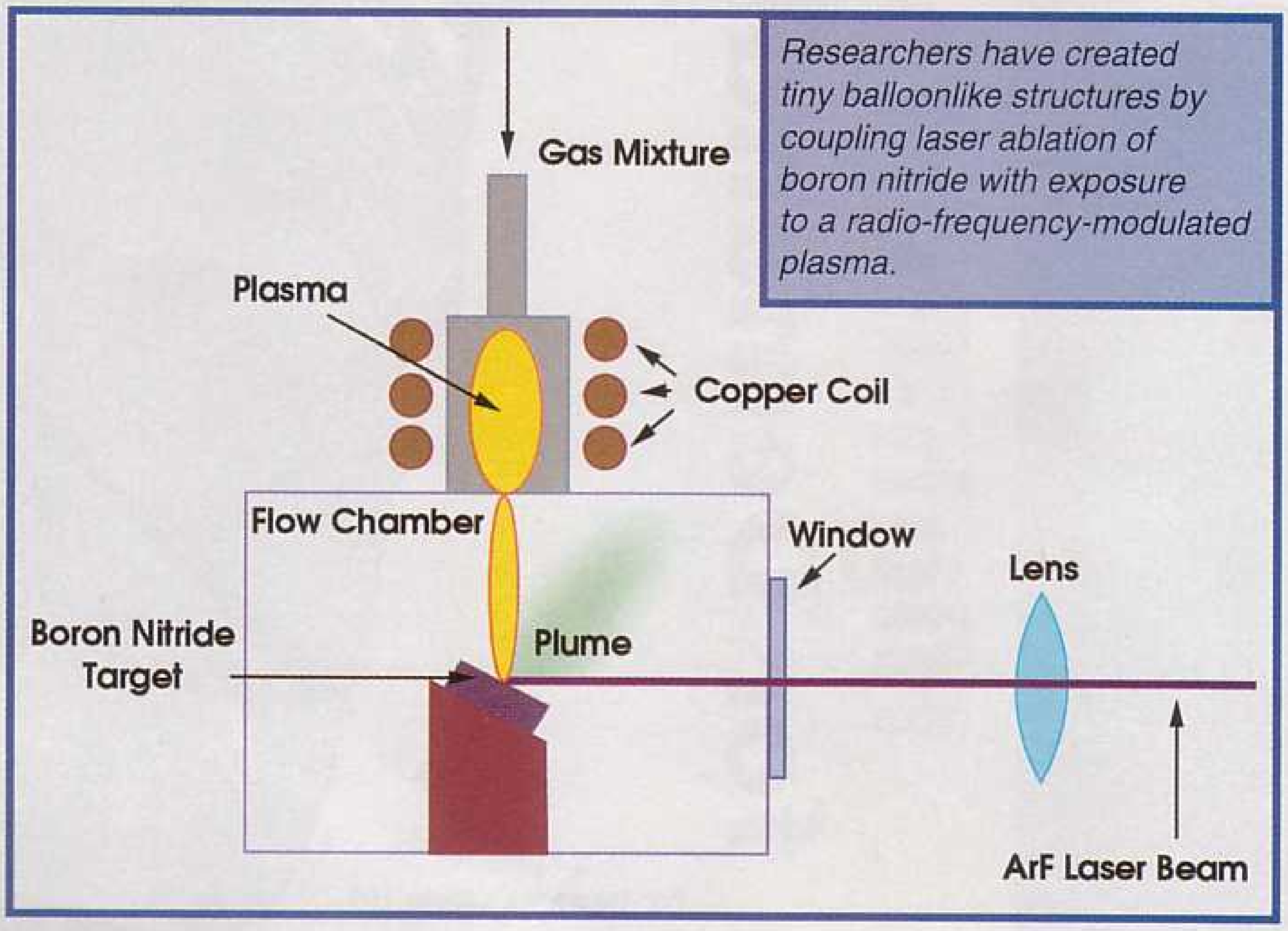
Michael D. Wheeler

Laser Yields Tiny Bubbles of Boron

IBARAKI, Japan — Don Ho is known for his "Tiny Bubbles in the Wine," but a research group is staking a claim to bubbles of boron. By synchronizing a laser-induced plasma with a radio-frequency-modulated plasma, the scientists have created tiny hollow balls of amorphous boron that are coated with a crystal shell of boron nitride. The balls, dubbed nanoballoons, could lead to applications in materials science, electronics and medicine.

The discovery of carbon structures such as fullerenes and nanotubes opened the door to investigations into and applications of other nanometer-size materials, explained Shojiro Komatsu, a researcher on the project from the National Institute for Materials Science. "We believe there are a lot of nanomaterials still undiscovered and that we first need to invent new synthesis methods to find them," he said. Such methods could be variants of laser ablation and laser vapor deposition.

The group, which also included researchers from Hosei University in Tokyo, selected boron nitride because



Researchers have created tiny balloonlike structures by coupling laser ablation of boron nitride with exposure to a radio-frequency-modulated plasma.