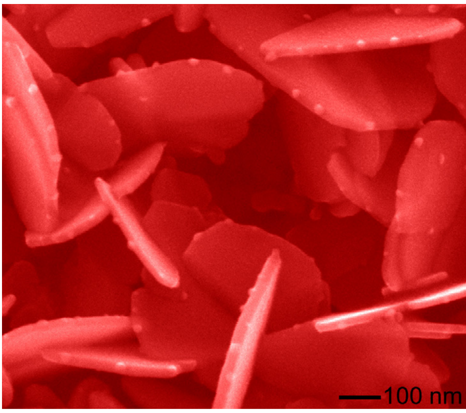
Argonne Scientists Watch the Birth of Nanoparticles for the First Time

Nanocrystal growth is the foundation of nanotechnology. Understanding it will allow scientists to more precisely tailor new and fascinating nanoparticle properties.

The Challenge

In order to understand how nanoparticles grow, scientists need to actually watch them in the act. The problem is that electron microscopy, the usual method for seeing down into the atomic level of nanoparticles, requires a vacuum. But many kinds of nanocrystals have to grow in a liquid medium—and the vacuum in an electron microscope makes this impossible.

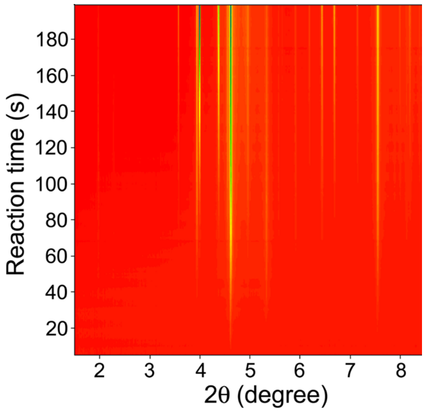
To circumvent this issue, scientists designed a special thin cell to allow a tiny amount of liquid to be analyzed in an electron microscope. However, it still limited research to a liquid layer just 100 nanometers thick, which is significantly different from the real conditions for nanoparticle synthesis. Because of the weak penetration of electrons in liquid, achieving high resolution structural information of nanocrystals was still impossible.



This image from a scanning electron microscopy shows silver nanoplates decorated with silver oxy salt nanoparticles along on its edges. These nanostructures were grown under irradiation of high-energy X-rays from the APS.

The Solution

To solve this conundrum, a team of scientists at Argonne National Laboratory and the Carnegie Institution of Washington used the very high-energy X-rays of Argonne's Advanced Photon Source (APS). The pattern of X-rays scattered by the sample allowed the researchers to reconstruct the earliest stages of nanocrystal growth second-by-second, enabling them to "watch" nanoparticles grow in real time for the first time.



X-ray diffraction patterns of the nanostructures grown were continuously recorded at one-second intervals. The appearance of more diffraction peaks along the reaction indicates the formation of nanoparticles made of new materials.

The Results

This groundbreaking technique revealed an abundance of information that researchers had never been able to uncover before, especially on the nucleation and growth steps of the crystals. This understanding of nanocrystal growth could potentially help synthesize high quality nanomaterials for photovoltaic solar cells, chemical and biological sensors and even imaging.

***"Getting a clear image of the growth process will allow us to control samples to get better results, and eventually, new nanomaterials that will have a wide range of applications,"* said Argonne nanoscientist Yugang Sun.**