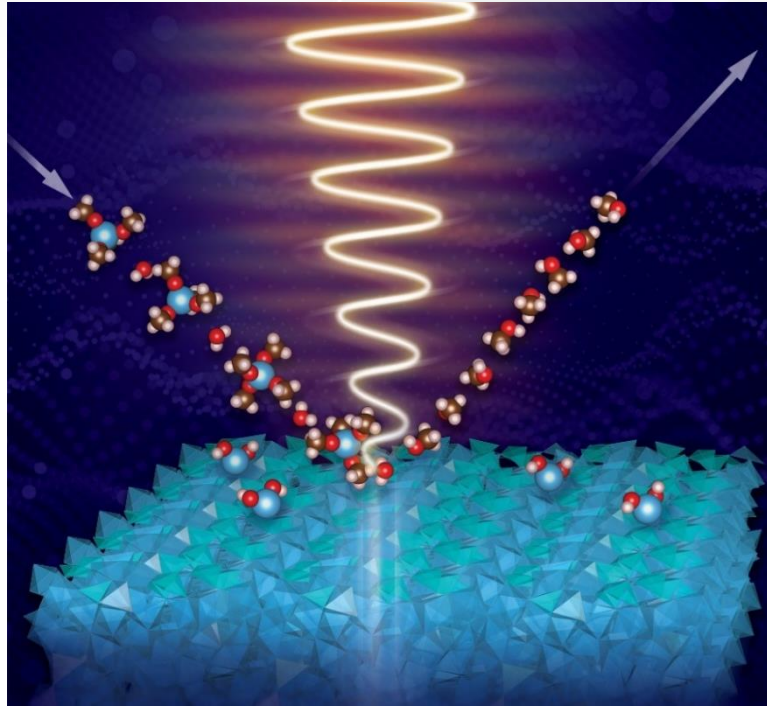


# Watch and Learn How Nanostructured Thin Films Grow



*Illustration of incoming precursor molecules reacting to grow titania, with residual molecules swept away. The growth process takes place under illumination by X-rays, which allow real-time observation of the process.*

X. H. Qu, D. H. Yan, R. S. Li, J. J. Cen, C. Y. Zhou, W. R. Zhang, D. Y. Lu, K. Attenkofer, D. J. Stacchiola, M. S. Hybertsen, E. Stavitski, M. Z. Liu, *Chem. Mater.* **33**, 5, 1740–1751 (2021).

*Work was performed in part at Brookhaven National Laboratory*

## Scientific Achievement

Scientists discovered a new mechanism for how titanium oxide thin films grow on complex, 3D nanoarchitectures and developed data analysis tools to deduce a new picture of growth.

## Significance and Impact

The in situ, X-ray spectroscopy techniques and data analytics methodologies developed in this work are a powerful toolset for understanding & improving vapor-phase film growth, with benefits for microelectronics, catalysis, and solar energy.

## Research Details

- Continuously collected x-ray absorption spectra during atomically-precise film growth at the ISS and BMM beamlines at NSLS-II.
- Discovered a prenucleation stage, a transition region, and steady state growth, and loosely-networked titanium polyhedra at the surface and interface regions.
- Used the CFN Theory & Computation, Materials Synthesis & Characterization, and Electron Microscopy Facilities.