22nd International Conference on
Diffusion in Solids and Liquids
22 TO 26 JUNE 2026 | RHODES, GREECE

ABSTRACT:

Next-Generation Light-Matter Interactions at Low-Dimensional Scale: Application of X-Ray Free Electron Lasers

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Smaller, faster, more intense: The X-Ray Free Electron Lasers (XFEL's) are opening up areas of research that were previously inaccessible. Using the X-ray flashes of XFEL's, scientists are able to map the atomic details of viruses, decipher the molecular composition of cells, take three-dimensional images of the nanoworld, film chemical reactions, and study processes such as those occurring deep inside planets.
To generate the X-ray flashes, bunches of electrons are first accelerated to high energies and then directed through special arrangements of magnets (undulators). In the process, the particles emit radiation that is increasingly amplified until an extremely short and intense X-ray flash is finally created. The world-unique feature of XFEL's is the possibility to provide up to hundreds of thousands ultra-short flashes (200 as - 100 fs) that makes these facilities particular suitable for time-resolved X-ray absorption, photoemission, (resonance) inelastic X-ray scattering as well as diffraction and imaging studies in the range of moderate and hard X-ray photons.

In this lecture main areas of nanoscale application will be presented taking examples of experiments done at the European XFEL in Hamburg.