

# Time- and length-scales of radiation damage processes

## Opportunity

Radiation damage processes are complex and inherently mesoscale phenomena. They span the spatial range from atomic to macroscopic and the temporal range from femtoseconds to years.

Due to this complexity, a full predictive capability of radiation damage accumulation still does not exist even for the simplest and well studied materials like Si.

## Meso Challenge

How can we gain an understanding of the dynamics of mesoscale damage processes? How do processes at the mesoscale relate the atomic scale defect mechanisms to macroscopic behavior of irradiated materials?

## Approach

This challenge could be addressed by ion-beam experiments aimed at revealing dynamics of defect interaction with adequate spatial resolution. These should be guided by a combination of experience, theory, and modeling. In such studies, a careful selection of material systems and irradiation conditions that allow for a gradual increase in complexity is essential.

## Impact

Understanding mesoscale aspects of radiation damage accumulation will help design the next generation of radiation-resistant materials and enable defect engineering of advanced devices.