

Neutron and X-ray-based non-destructive material testing at the Budapest Neutron Centre

László Szentmiklósi¹, László Rosta¹, Zoltán Kis¹, Márton Markó¹

¹Budapest Neutron Centre, Centre for Energy Research, Hungarian Research Network, Hungary

Neutron-based methods play an increasingly important role in non-destructive material testing and ideally complement the mainstream NDT methods in terms of amenable materials, sample geometries, and penetration depth. The Budapest Neutron Centre (BNC), with its 10 MW research reactor and 16 beamline instruments, is the fifth most significant neutron center in Europe. Its facilities and the related specific competencies are offered to the scientific community via excellence-based transnational access systems, as well as to our industrial R&D partners. The measurement techniques make use of the diverse interactions between neutrons and condensed matter, including capture, scattering, and absorption. These allow us to characterize the material for elemental composition (Prompt-gamma activation analysis (PGAA), Instrumental Neutron Activation Analysis (INAA)), for nanoscale and atomic-level structure (Small-angle neutron scattering (SANS) and neutron diffraction (ToF-ND), respectively), or do advanced 2D, 3D or time-dependent visualization (radiography and tomography with neutrons, or X-rays, or with the combination of the two). These neutron techniques can also be combined, or extended with X-ray-based studies, to solve complex industrial quality issues, assist in root cause analysis, and help product development. The lecture will highlight the technical merits of our material characterization techniques and illustrate their industrial applicability with real-world case studies from the recent past.