Contribution ID: **54** Type: **Oral Presentations**

Residual stress analyses using diffraction techniques

Monday, 16 November 2015 12:20 (20 minutes)

Residual stress is a double-edged sword since tensile stresses, especially when existing close to surfaces, can lead to component failure due to stress corrosion cracking, whist compressive stresses mitigate against crack formation and propagation. Diffraction techniques enable analyses of the prevailing residual stress conditions from direct investigation of the lattice plane spacing. By combining this property with penetrating radiation such as hard X-rays and thermal neutrons, depth-resolved information can be obtained.

Using hard X-rays (energies larger than 65 keV) produced in synchrotron facilities has made possible the elucidation and quantification of depth influences resulting from:
• Surface stress modification treatments such as shot peening to enhance fatigue lifetimes in steel samples;
• WC-Co hard metal coatings on substrates that rendered extensive differences in the coefficient of thermal expansion between such coating and the substrates. This leads to interactive thermal stresses that may be beneficial to both the coating and the substrate.
Notwithstanding the capability of depth profiling to typically 50 µm resolution, data quality is strongly influenced by grain statistics. With neutron diffraction investigations larger gauge volumes need to be employed that largely mitigates the latter effects.

We shall report on the complementary use of X-ray and neutron strain analyses towards depth-resolved investigations of these systems.

References:

[1] S.Y. Zhang, A.M. Venter, W.J.J. Vorster and A.M. Korsunsky (2008) High-energy synchrotron X-ray analysis of residual plastic strains induced in shot-peened plates, J. Strain Analysis 43, 229-241.
[2] T.-S. Jun, A.M. Venter and A.M. Korsunsky (2011) Inverse eigenstrain analysis of the effect of non-uniform sample shape on the residual stress due to shot peening, Experimental Mechanics 51:165-174. doi 10.1007/s11340-010-9346-2
[3] Andrew M. Venter, O. Philip Oladijo, Vladimir Luzin, Lesley A. Cornish, Natasha Sacks, Performance characterization of metallic substrates coated by HVOF WC–Co, Thin Solid Films 549, 330–339
[4] Andrew M Venter, Vladimir Luzin, O Philip Oladijo, Lesley A Cornish and Natasha Sacks (2014) Study of interactive stresses in thin WC-Co coating of thick mild steel substrate using high-precision neutron diffraction, Materials Science Forum 772, 161-165

Primary author: Dr VENTER, Andrew (Research and Development Division Necsa SOC Limited; DST-NRF Centre of Excellence in Strong Materials)

Presenter: Dr VENTER, Andrew (Research and Development Division Necsa SOC Limited; DST-NRF Centre of Excellence in Strong Materials)

Session Classification: Scientific Talks

Track Classification: Main