# ABSTRACT

High temperature oxidation of $Pt_{84}$:$Al_{11}$:$Cr_3$:$Ru_2$ (at.%) in air between 1150°C-1350°C, for up to 500 hours in both water-quenched and air-cooled specimens was investigated. Mass gains and thicknesses of the $Al_2O_3$ scales were measured. Surface and cross-section morphologies of the oxide scales were examined using a field-emission scanning electron microscopy with EDS. Cross-sectional examination was also done by cutting the samples in a cross beam FIB workstation. Phase identification was done with X-ray diffraction and Raman spectrometry. Room temperature stresses in the oxide scales were measured by using an argon-ion laser, and were found to be compressive and low.

Well-adhering and protective external $\alpha$-$Al_2O_3$ scales formed on all specimens, without spallation. Cross sections showed protrusions of the alloy into the scale; which allowed mechanical keying of the scale to the substrate, and were mainly responsible for the good adherence. No internal oxidation was observed. Parabolic scale growth kinetics were established, and rate constants and activation energies were deduced. Oxidation rates in both the quenching media were close at lower exposure temperatures, while at higher temperatures, the scale growth rate of the air-cooled specimens was faster.

Microscopic observations showed that the oxide grain sizes increased with increased oxidation time at all temperatures, and the morphology changed from small flakes to large oxide grains with time. The growth mechanism of the $\alpha$-$Al_2O_3$ scale was proposed to be mainly by inward diffusion of oxygen along the oxide grain boundaries, with some outward diffusion of aluminium ions along the short circuit paths.

Oxidation of both water-quenched and air-cooled $Pt_{84}$:$Al_{11}$:$Cr_3$:$Ru_2$ (at.%) specimens followed the same trends, with water-quenched specimens displaying slightly better properties. Compared to most other Pt-, Ni-and Fe-based superalloys, the scales on $Pt_{84}$:$Al_{11}$:$Cr_3$:$Ru_2$ (at.%) specimens possessed slower growth rates, lower activation energies and room-temperature compressive stresses. Thus, $Pt_{84}$:$Al_{11}$:$Cr_3$:$Ru_2$ (at.%) possesses potential for high temperature applications.