

----- GENERAL INFORMATION -----

DATA TITLE: Comparison of results from Raman and EDS/SEM analysis of ferritic Cr-Mo-V steel T91 (UNS: K90901) cross-sectioned after oxidation at 1200 C for 2 hrs in air

PROJECT TITLE: Materials Characterization of High-Temperature Oxidation on ferritic Fe-Cr-Al-Mo alloy Kanthal APMT and Cr-Mo-V steel T91 (UNS: K90901)

DATA ABSTRACT: Raman images and energy dispersion x-ray spectroscopy (EDS) elemental analysis maps acquired from a cross-sectioned segment of ferritic Cr-Mo-V steel T91 (UNS: K90901) after oxidation in air at 1200 C for 2 h. Raman data was collected using a WITec alpha 300R micro-imaging Raman microscope. EDS data was collected using a JEOL 7600F scanning electron microscope equipped with an Oxford Instruments EDS 80 mm² X-Max silicon drift detector (129 eV resolution) operated through the INCA™ software suite. Results from Raman and EDS corroborates, identifying the chemical formula of an Cr-Fe oxide compound observed in the cross-section as $\text{Fe}_{(3-x)}\text{Cr}_x\text{O}_4$.

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ASSOCIATED PUBLICATIONS:

T. Copeland-Johnson, C.K.A. Nyamekye, S.K. Gill, L. Ecker, N. Bowler, E.A. Smith, R.B. Rebak, Characterization of Kanthal APMT and T91 oxidation at beyond design-basis accident temperatures, Corros. Sci. (2020).

COLLECTION INFORMATION:

Time period(s): 2017-2019

Location(s): Iowa State University, Brookhaven National Laboratory

----- FILE DIRECTORY -----

----- FILE LIST-----

File Name	Description
EDS_T91_Air.jpg	BSE image taken at a cross-section of T91 after oxidation in air
EDS_T91_Air_Cr.jpg	EDS elemental map generated showing the distribution of Cr in EDS_T91_Air.jpg

EDS_T91_Air_O.jpg	EDS elemental map generated showing the distribution of Cr in EDS_T91_Air.jpg
EDS_T91_Air_O+Fe+Cr.jpg	EDS elemental map overlapping data shown in EDS_T91_Air_Cr.jpg, EDS_T91_Air_O.jpg, and EDS_T91_Fe.jpg
EDS_T91_Fe.jpg	EDS elemental map generated showing the distribution of Cr in EDS_T91_Air.jpg
Raman_T91_Air_Filter Scale.png	Intensity scale for Raman shift 677 cm^{-1} filter image in Raman_T91_Air_Filter@677.png
Raman_T91_Air_Filter@677.png	Raman filter image showing the distribution of Raman shift located at 677 cm^{-1} in the site of interest shown in Raman_T91_Air_Image.png
Raman_T91_Air_Filter@CCD-41cts.txt	Tab-delimited text file of Raman spectra signifying the minimum intensity, -41 counts (cts), at which the Raman shift 677 cm^{-1} was detected in Raman_T91_Air_Filter@677.png
Raman_T91_Air_Filter@CCD173cts.txt	Tab-delimited text file of Raman spectra corresponding to the maximum intensity, 173 counts (cts), at which the Raman shift 677 cm^{-1} was detected in Raman_T91_Air_Filter@677.png
Raman_T91_Air_Filter_Metadata.txt	Metadata for acquisition parameters used to acquire the Raman image in Raman_T91_Air_Filter@677.png
Raman_T91_Air_Image.png	Optical microscope image of a site of interest captured from a cross-sectioned segment of T91 after oxidation in air for 2 hrs
Raman_T91_Air_Image_Metadata.txt	Metadata for acquisition parameters used to acquire the optical microscope image in Raman_T91_Air_Image.png

----- METHODS AND MATERIALS -----

----- DATA COLLECTION METHODS -----

The Raman image was captured with a WITec alpha 300R microscope. The WITec alpha microscope was equipped with dual lasers operating at 532 and 785 nm, the former was used for Raman imaging. A 100 g/mm grating was utilized. The WITec alpha microscope was capable of a $\sim 1\ \mu\text{m}$ spatial resolution, illustrating the distribution of Raman active compounds in areas up to $2500\ \mu\text{m}^2$. Raman spectra were collected under an integration time of 0.23 or 1 s.

----- DATA PROCESSING METHODS -----

Raman filter images, scan data, and metadata files were exported from WITec Control 4 software suite.

EDS maps were generated and exported using the INCA analysis interface as .jpg files.

----- SOFTWARE -----

Name: WITec Control

Version: 4

System Requirements: N/A

URL: <https://www.witec-instruments.com/>

Developer: WITec Wissenschaftliche Instrumente und Technologie GmbH

Name: INCA™ - The Microanalysis Suite

Version: 4.15

System Requirements: N/A

URL: <https://www.oxinst.com>

Developer: Oxford Instruments

----- EQUIPMENT -----

Manufacturer: WITec

Model: Alpha 300R

Embedded Software/Firmware Name: (if applicable) N/A

Embedded Software/Firmware Version: (if applicable) N/A

Manufacturer: JEOL

Model: 7600F

Embedded Software/Firmware Name: (if applicable) N/A

Embedded Software/Firmware Version: (if applicable) N/A

Additional Notes: Equipped with Oxford Instruments EDS 80 mm² X-Max silicon drift detector (129 eV resolution) operated through the INCA software suite.

----- LICENSING -----

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