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Investigation of wear and corrosion products from around explanted CoCrMo tapers

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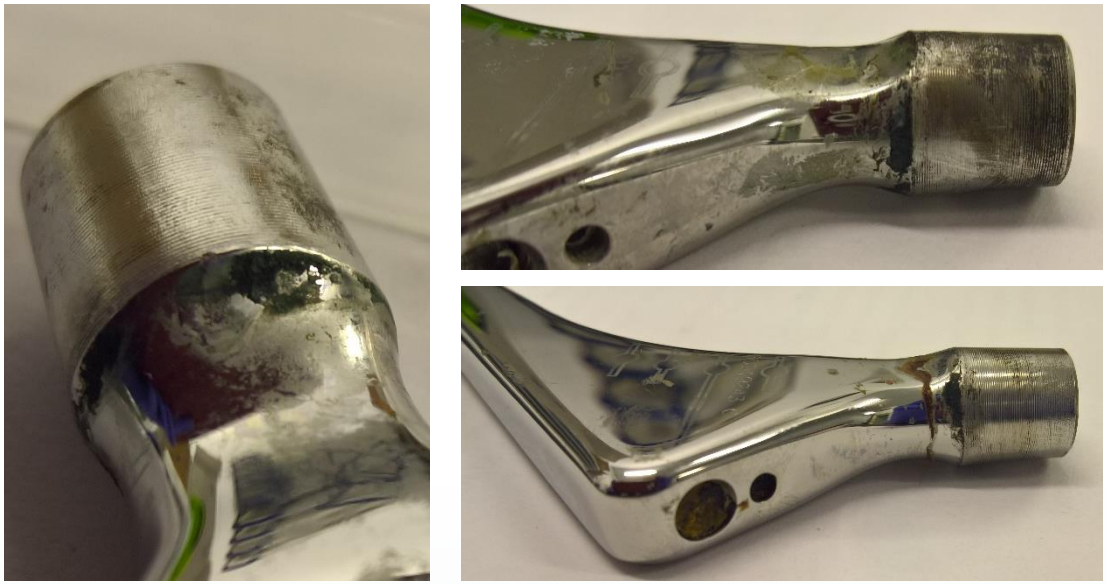
Objectives



Debris around revised tapers

- Understand the morphology of debris from *micro* scale down to the *nano* level
- Investigate the chemical composition of wear and corrosion products
- Determine the size distribution of particulate debris (PSD)
- Correlate debris characteristics with wear mechanisms

Methods

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Retrievals
1 x CPT/ADEPT and 1 x CPT/BHR

Forensically investigation: RedLux

	Native debris (untreated)	**Digested debris** (12M KOH)	
Micro scale	SEM/EDX FEI Quanta 200	TEM/EDX Tecnai T12	STEM/EDX JEOL ARM 200F (cold-FEG)
Nano scale			

Results – RedLux and SEM/EDX

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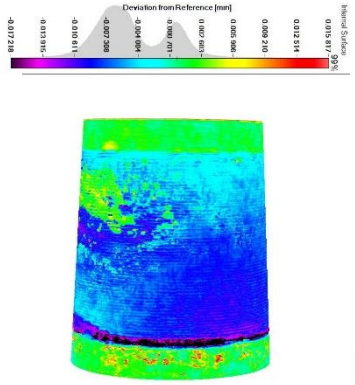
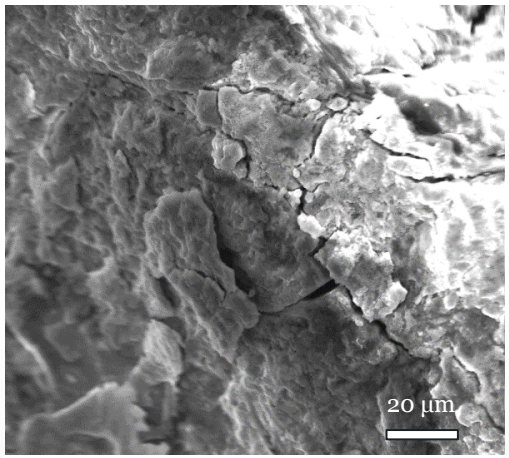
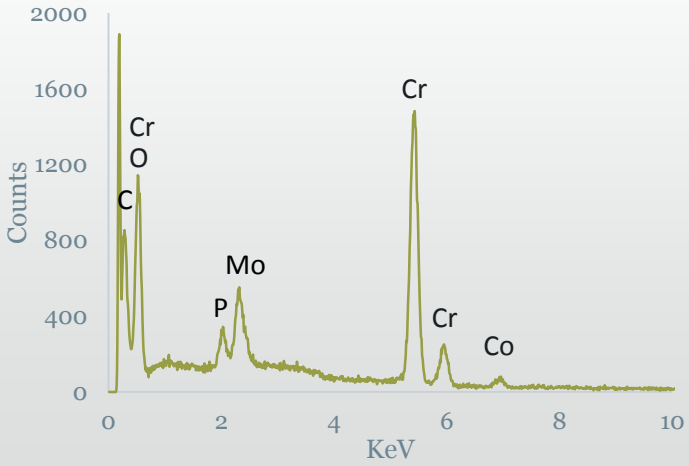
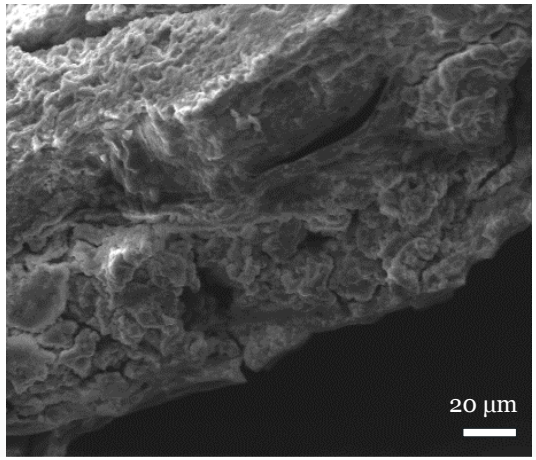
Non-toggling head (CPT/ADEPT)

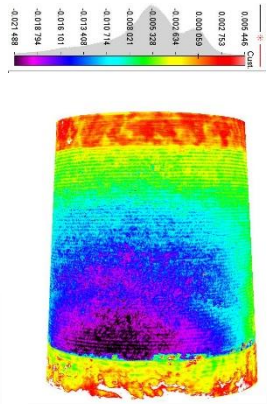


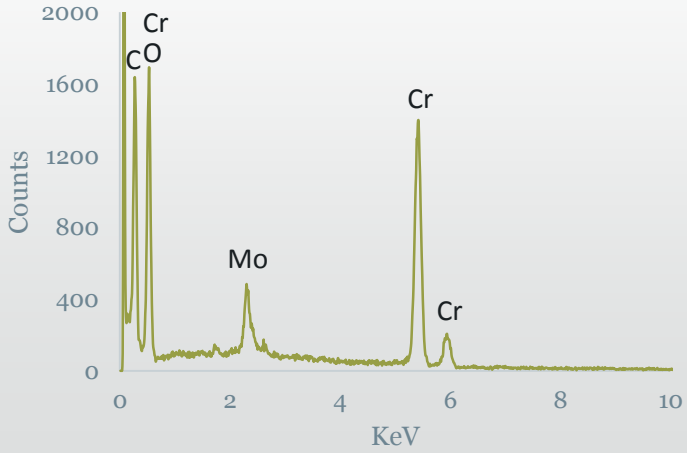




Toggling head (CPT/BHR)







Results – Morphology and size

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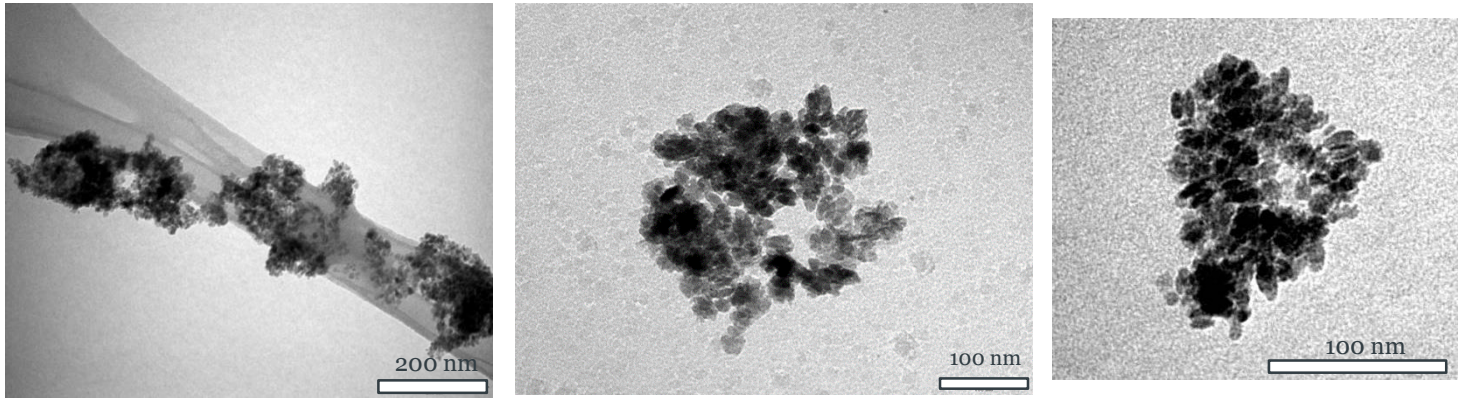
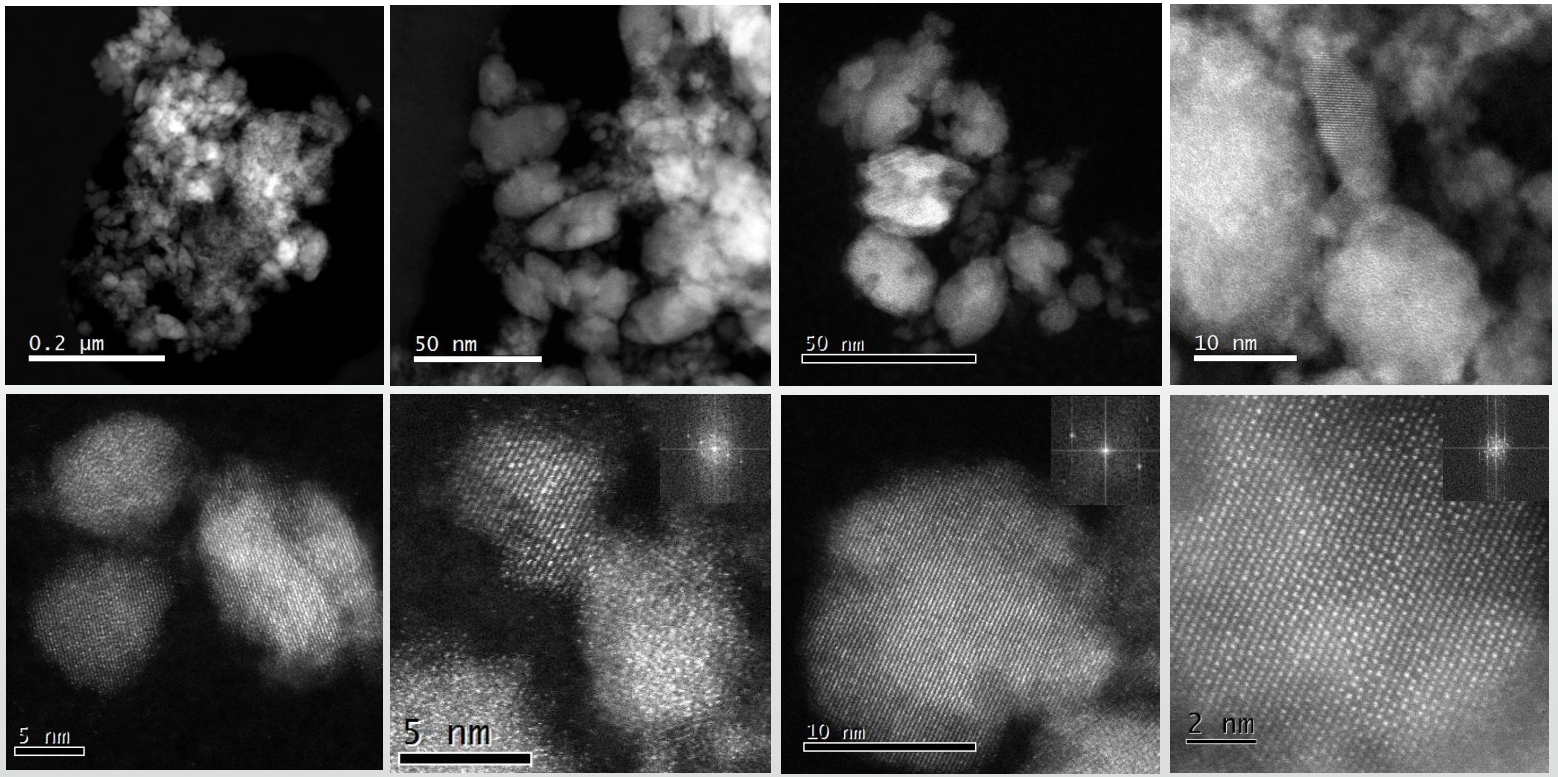
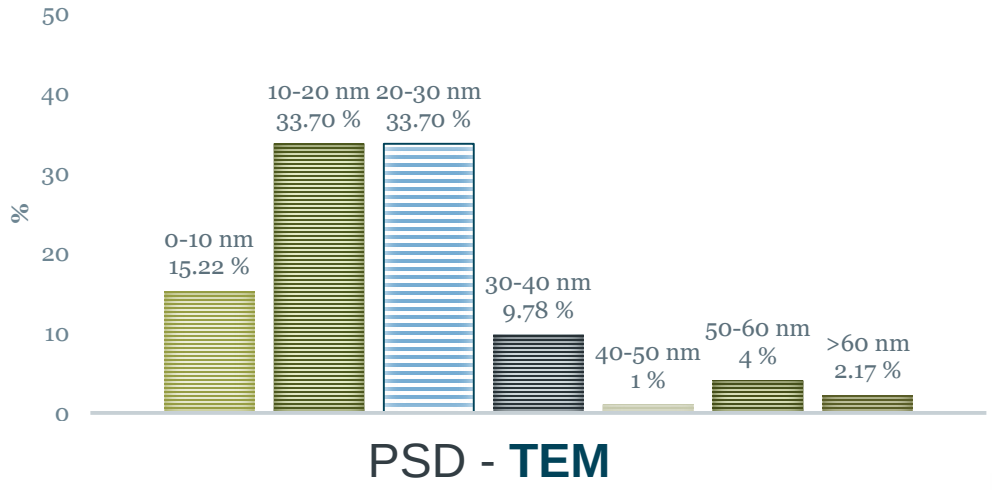
TEM



STEM

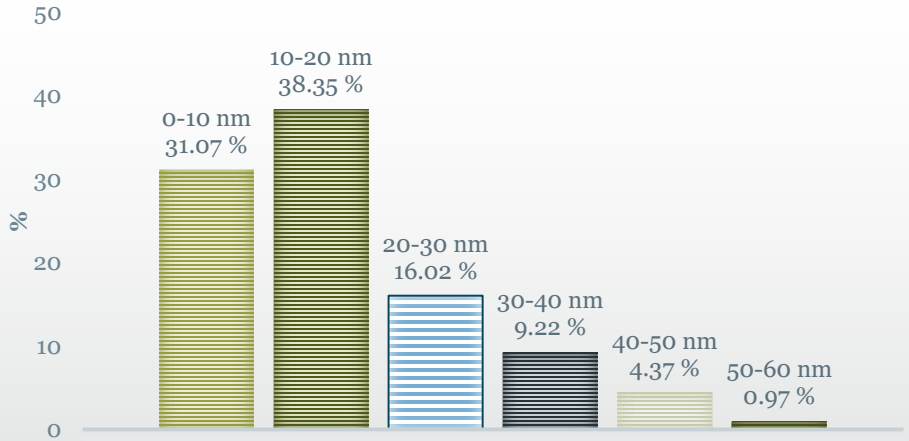


Results – Particle size distribution (PSD)



PSD - **TEM**

Size range	3.64 nm – 97.89 nm
Mean d_{max}	22.52 nm
Median d_{max}	20.89 nm
Round particles	50.00%
Oval particles	39.13%
Needle shaped particles	10.87%



PSD - **STEM**

Size range	2.77 nm – 59.77 nm
Mean d_{max}	17.41 nm
Median d_{max}	14.47 nm
Round particles	65.05%
Oval particles	33.98%
Needle shaped particles	0.97%

T-test<0.05

Statistically different results

Results – Particle composition

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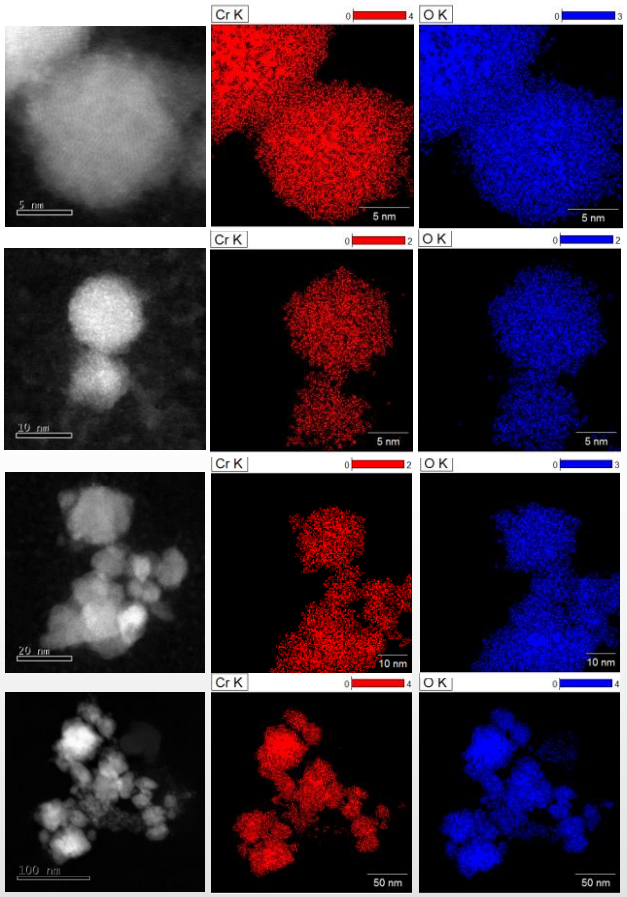
STEM and EDX mapping



Composition		
Element line	Element Wt.%	Wt.% error
Cr K	83.84	±0.65
Co K	16.15	±1.44
Mo K	0.01	±0.01

Element line	Element Wt.%	Wt.% error
Cr K	87.71	±1.31
Co K	11.00	±1.96
Mo K	1.29	±0.60

Element line	Element Wt.%	Wt.% error
Cr K	91.07	±1.24
Co K	7.47	±1.91
Mo K	1.46	±0.65

Element line	Element Wt.%	Wt.% error
Cr K	85.62	±0.70
Co K	13.08	±1.35
Mo K	1.30	±0.32

Summary

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- The study provides a comprehensive understanding of the micro and nano structure of debris released from CoCrMo taper junctions
- It shows reliable evidence of Cr rich NPs released *in-vivo* from metallic contacts other than MoM bearings
- The analysis of STEM micrographs provided a PSD shifted towards the lower size range, as compared to TEM
- No significant difference could be seen between debris released from toggling and non-toggling CoCrMo tapers

Acknowledgements

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