PS2 #1865 Cell Identification and Sub-Cellular Chemical Characterization Using HD FTIR-Imaging: A Multivariate Analysis

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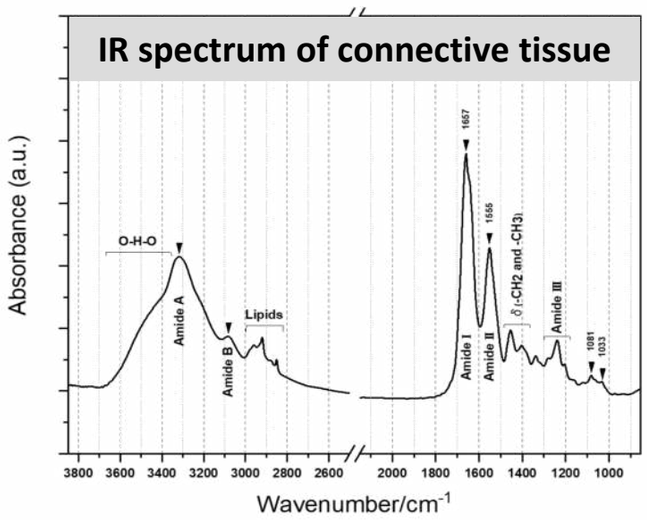
Introduction

- **Corrosion** products and **wear** debris generated from total hip replacements (THR) often lead to **premature implant failure**.
- Clinical histopathological practice is limited in identifying **biochemical alternations**.
- High definition Fourier transform infrared micro-spectroscopy imaging (**HD FTIR-I**) enables rapid chemical identification with a high spatial resolution.

Purpose:

To characterize different pathological patterns associated with varying particulates using HD FTIR imaging

Methods



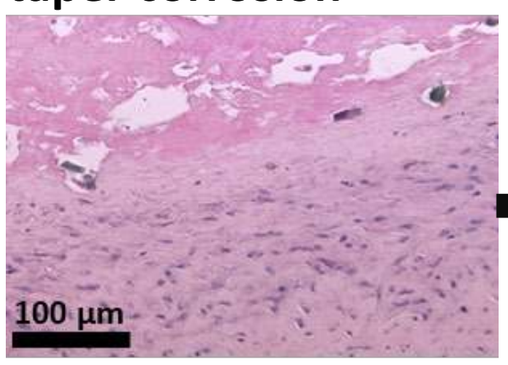
Work Flow	
Sample format	5 µm FFPE fixed tissue section
Sample substrate	BaF_2 slide
Sampling mode	Transmission (pixel: 1.1×1.1 µm²)
Data acquisition	Hyperspectral data cube
Pre-processing	Quality test; baseline correction
Data analysis	Chemical Imaging; clustering

Highlights:

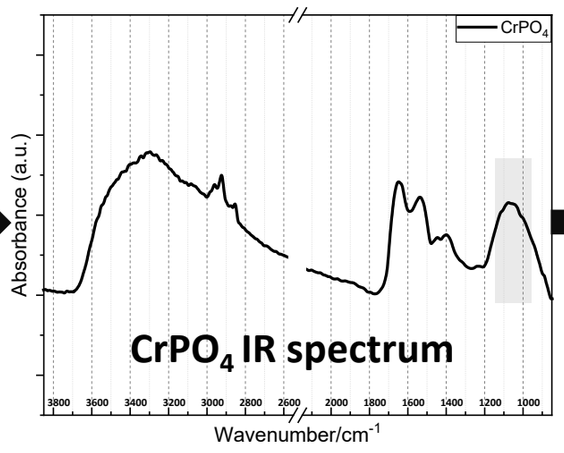
- Entirely non-perturbing sample preparation;
- High-throughput imaging data;
- Unsupervised learning or hierarchical cluster analysis (**HCA**) use recorded local spectrum to relate data to underlying physiologic condition.

Results

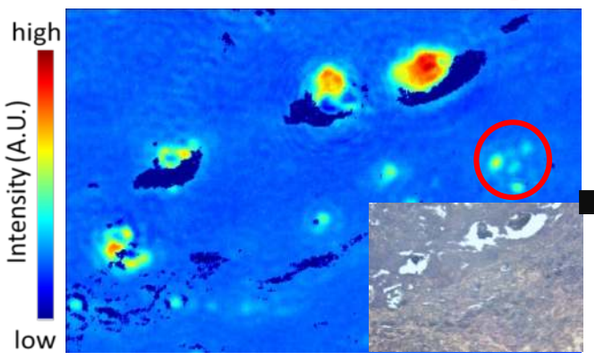
Identification of $CrPO_4$ particles, fibrin exudate, and macrophages within capsule tissue from a MoP THR with **taper corrosion**



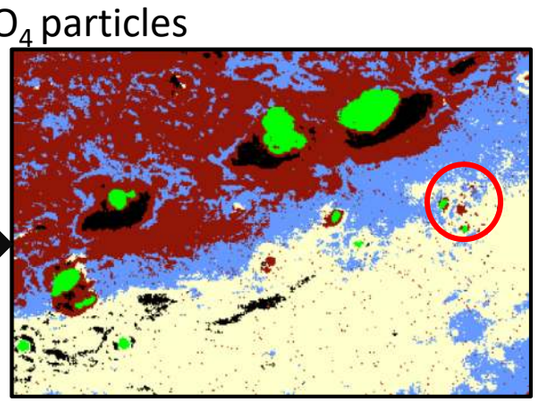
H&E image



fine $CrPO_4$ particles

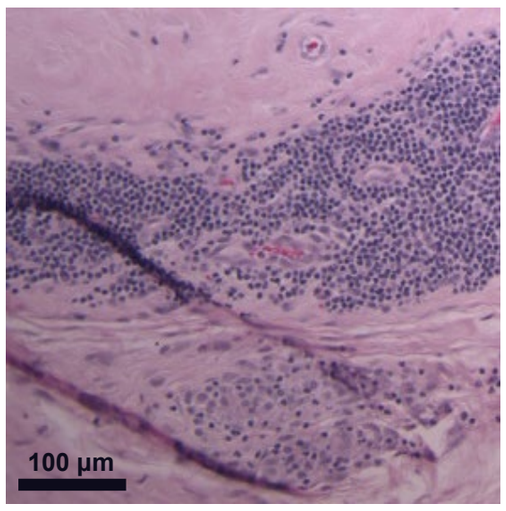


chemical image showing phosphate (~965 cm^{-1})

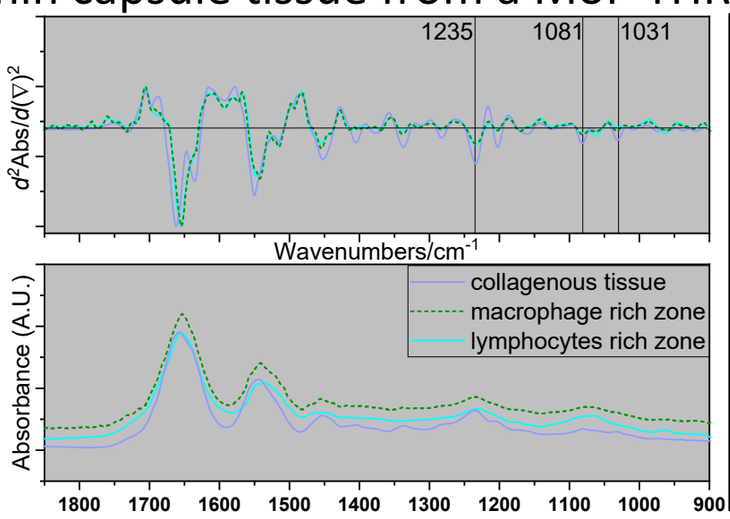


4-cluster **HCA** image

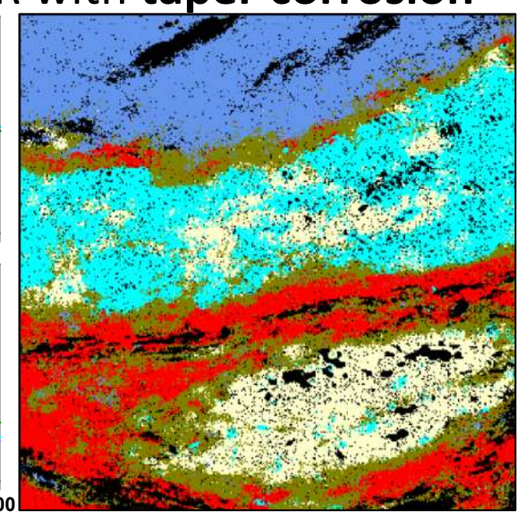
Cell differentiation within capsule tissue from a MoP THR with **taper corrosion**



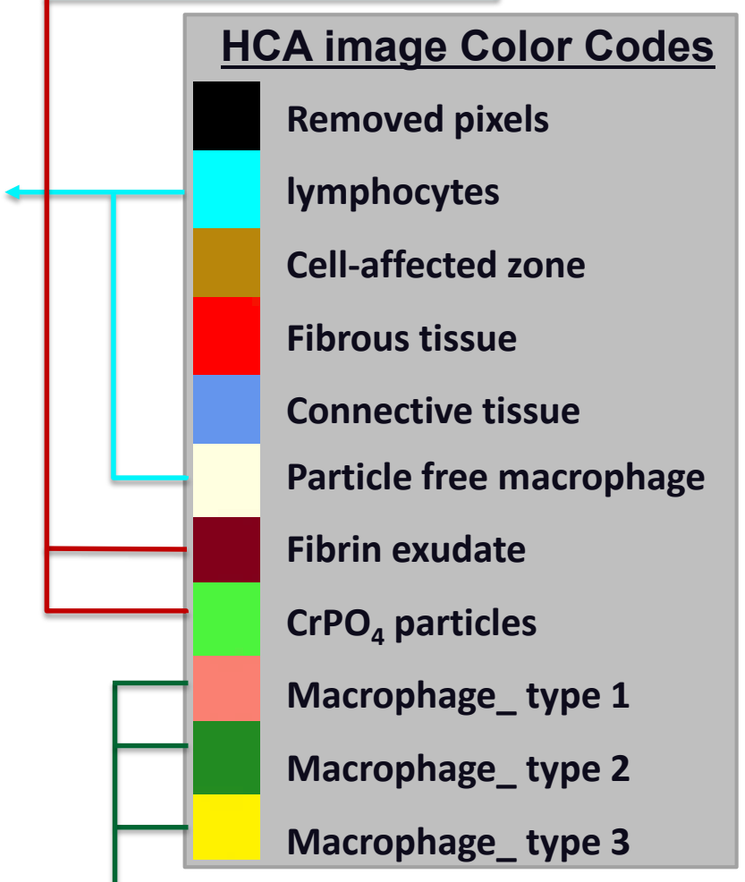
H&E image



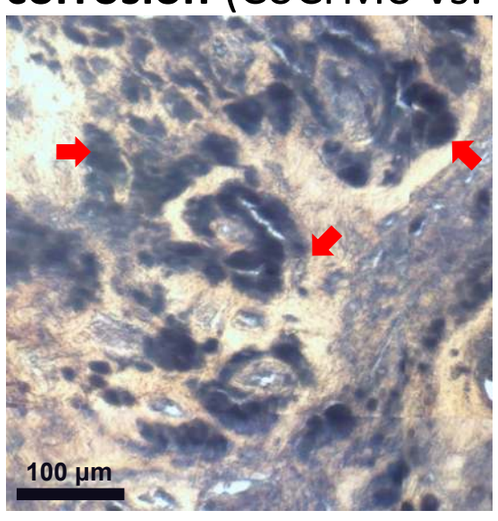
Spectrum "fingerprints"



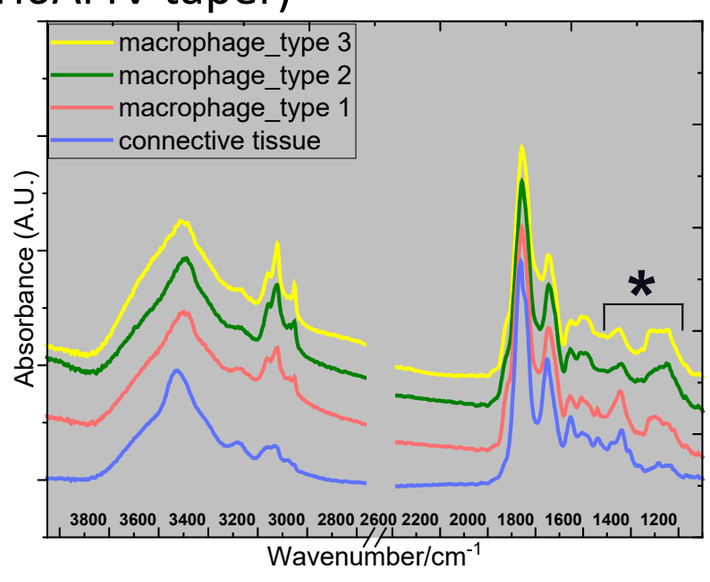
5-cluster **HCA** image

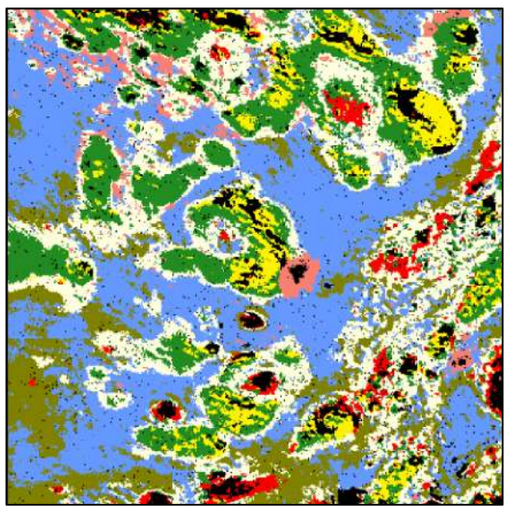


Particles uptake by macrophages: capsule tissue from a MoM case with **taper corrosion** (CoCrMo vs. Ti6Al4V taper)



3x3 mosaic image





7-cluster **HCA** image

➡ **Macrophage**
* **Indirect evidence of particle species from nucleic acid & amide III region**

Conclusion

- HD FTIRI provides a fast method to characterize wear and corrosion debris at a high level of spatial detail.
- Multivariate FTIRI approach, specifically HCA, is a promising tool for spectral histopathology to aid in clinical diagnosis and quantification of histopathological patterns.

➡ For example, macrophages can be distinguished based on particle contents.

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