CHARGE AND HEAT TRANSFER DYNAMICS IN SILVER–PLATINUM ANTENNA-REACTOR NANOPARTICLES

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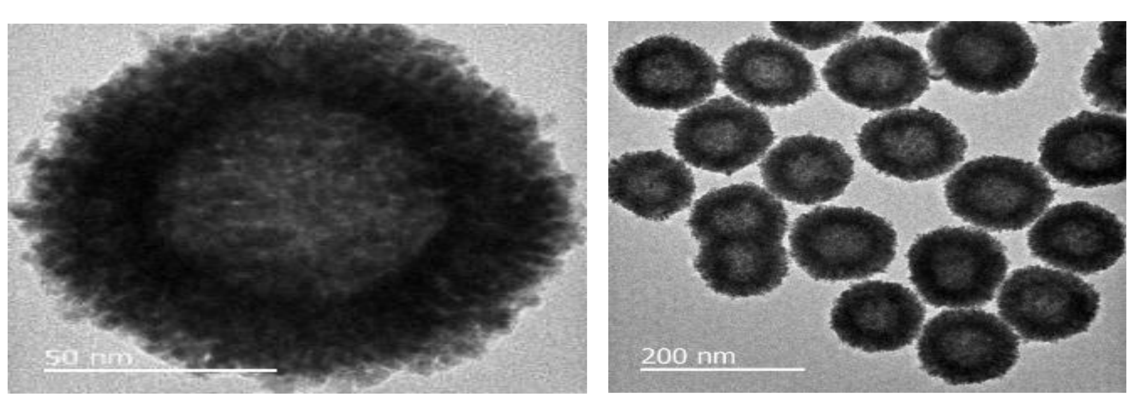
BACKGROUND

- Plasmonic metals (Au, Ag) harvest light efficiently but are poor catalysts; catalytic metals (Pt, Pd) are reactive but absorb weakly.
- Antenna–reactor nanoparticles pair an optically active core (antenna) with catalytically active satellites (reactor), bridging light absorption and catalytic activity.



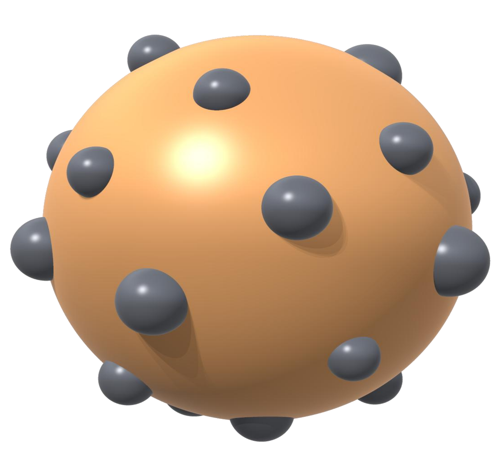


Fig 1 TEM Images of Ag-Pt Antenna Reactors of 70nm

EXPERIMENTAL DESIGN

- Sample delivery: Ag–Pt NPs dispersed in water, delivered by a liquid jet.
- Optical pump: 343 nm (third harmonic of 1030 nm), exciting the plasmon resonance of the Ag core.
- X-ray probe: Pt L3 edge (11,564 eV) with focused optics, for both XANES and EXAFS.
- Time resolution: 100ps 200ps and 500ps.
- Collected in Fluorescence mode.

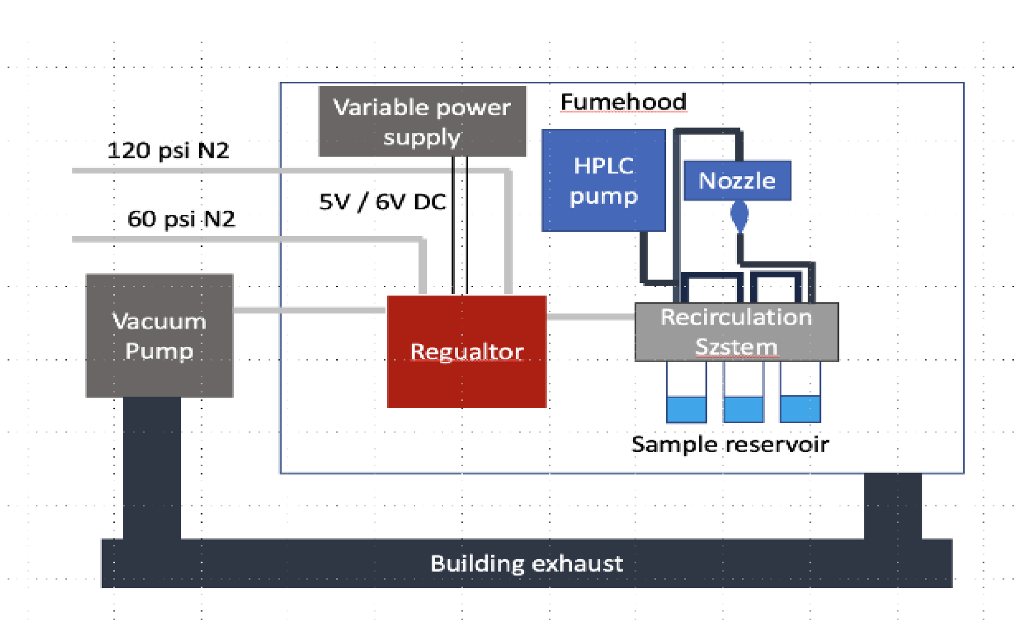


Fig. 2 — Schematic of the Liquid Jet Pump Probe X-Ray Absorption Spectroscopy Setup.

DATA ANALYSIS

- The Aim of this experiment was to find the relative number 5d-holes in Pt L3 edge.
- Python was used to analyze the XANES (X-ray Absorption Near Edge Structure and XAFS Data.

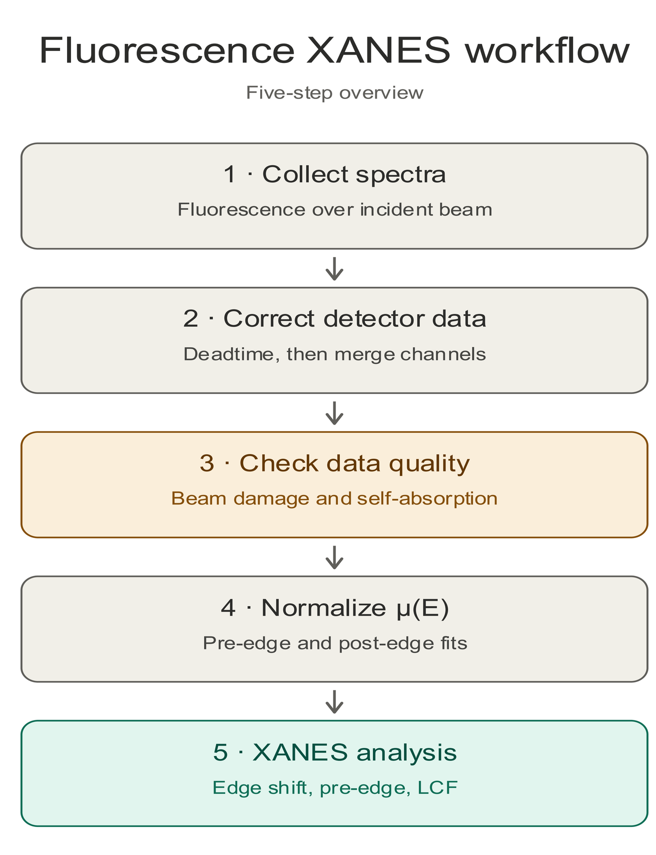


Fig.3 Analysis Workflow for XANES data

RESULTS

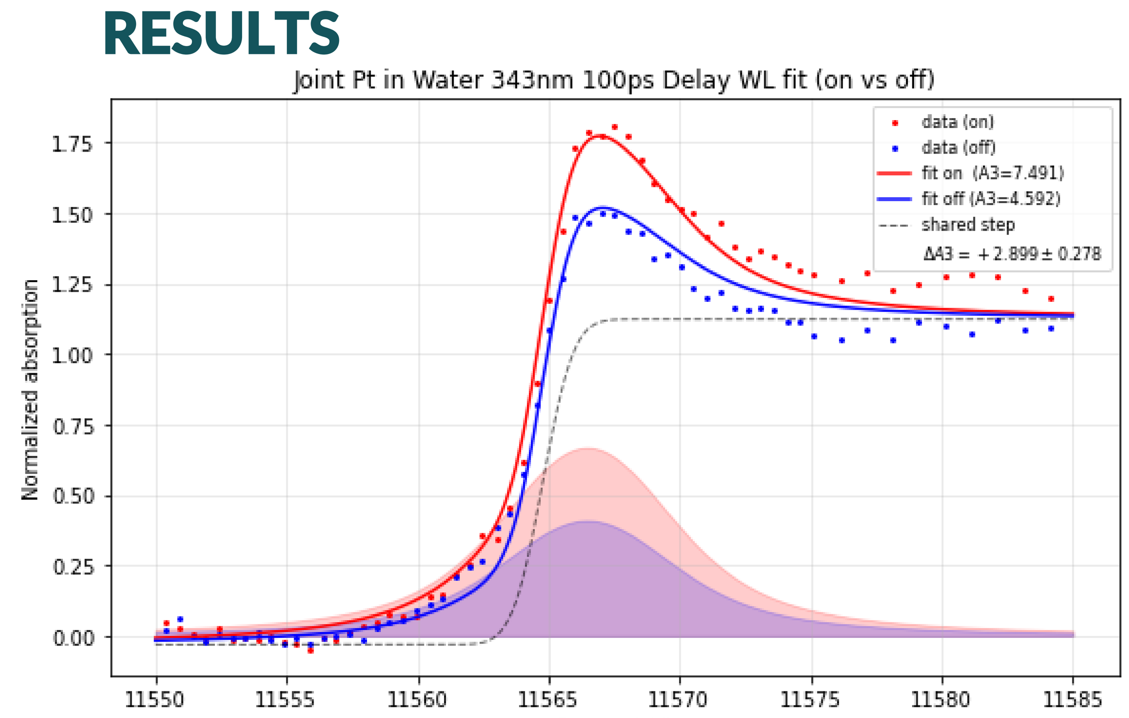


Fig.4 Voigt fit for Pt Nanoparticles in Water

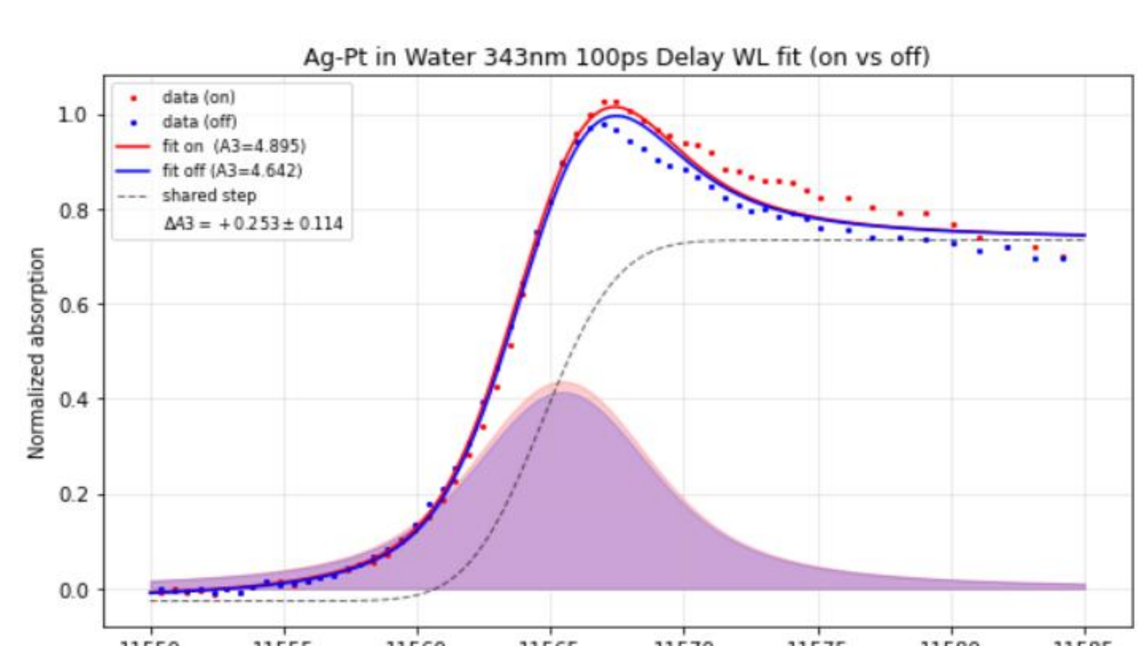


Fig.4 Voigt fit for Ag-Pt Nanoparticles in Water

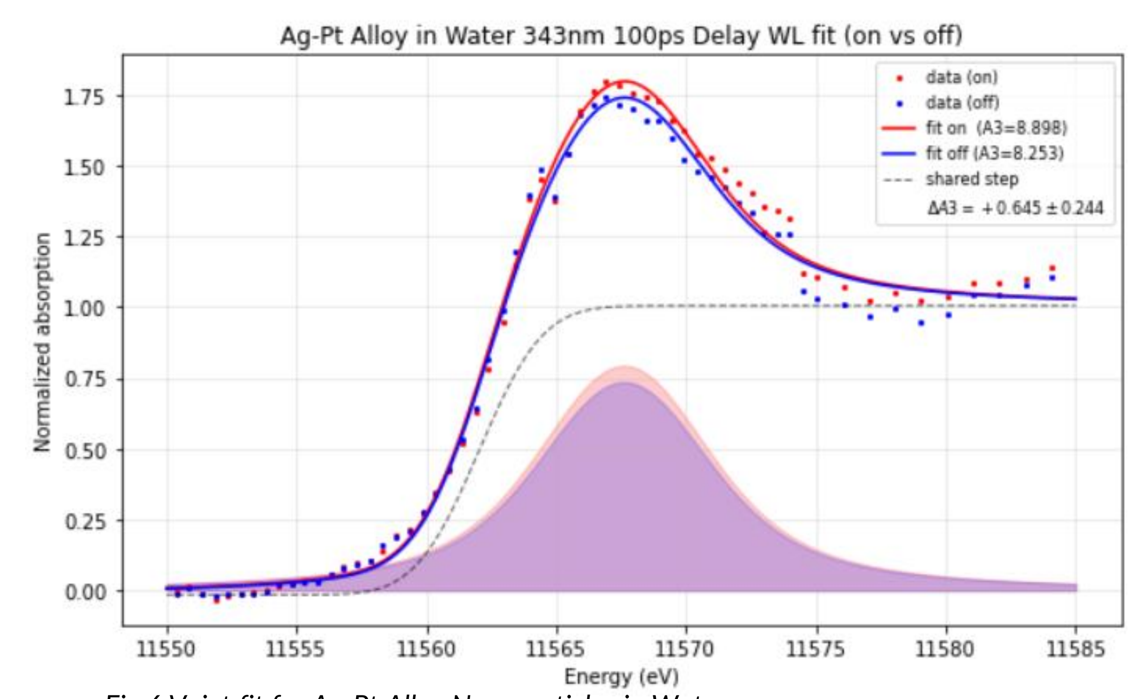


Fig.6 Voigt fit for Ag-Pt Alloy Nanoparticles in Water

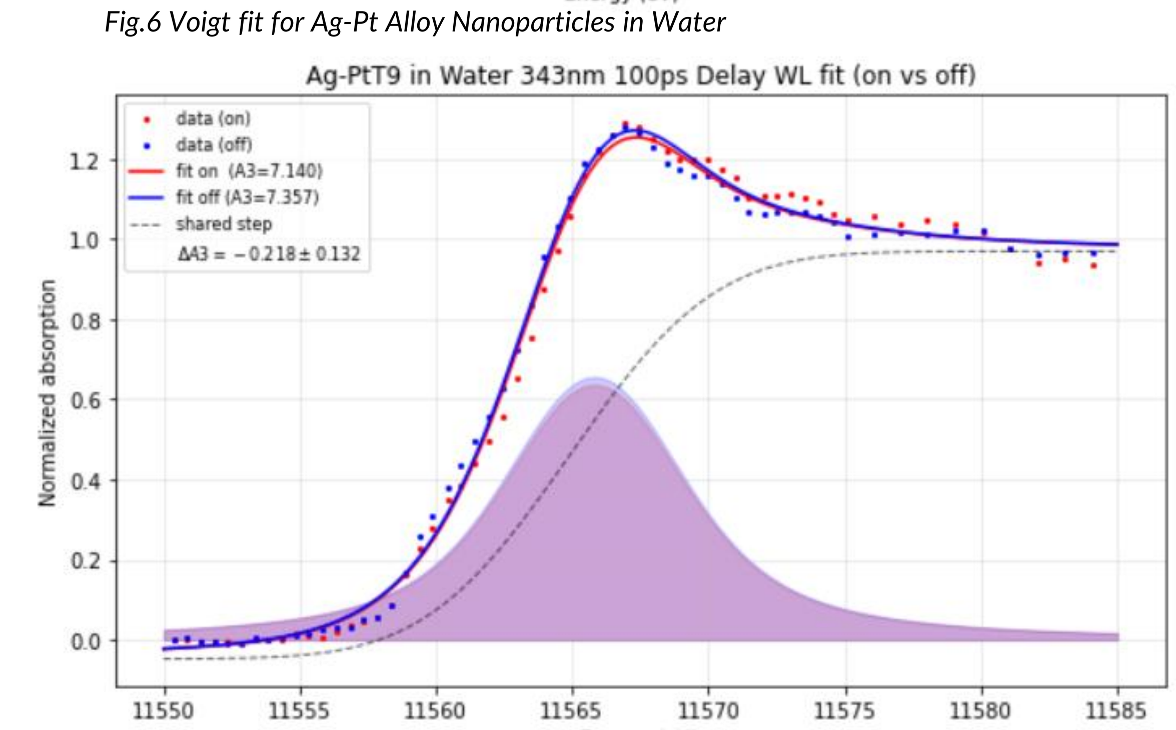


Fig.6 Voigt fit for Ag-Pt T9 Nanoparticles in Water

SAMPLE	ΔA3	Δ5d
Pt NPs	2.885	0.587
Ag-Pt	0.253	0.0448
Ag-Pt T9	-0.218	-0.0531
Ag-Pt Alloy	0.645	0.0489

CONCLUSION

- Energy calibration is the main limitation of this dataset. Without reference spectra recorded simultaneously for alignment, absolute edge positions carry systematic uncertainty.
- Additional scans and a correction for concentration loss would be needed to establish these differences as significant

FUTURE WORK

- Calculate the relative number of 5d holes across various times delays, fluences, and samples.
- Run comparison against other Antenna Reactor Nanoparticles such as the Au-Pd.

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