

Final Report

Name of BritInn Fellow: Ethan M Cunningham

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Home University: University of Oxford

Guest Department: Institut für Ionenphysik und Angewandte Physik

Guest University: Universität Innsbruck

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Title of the Research Project: Photocatalytic Reaction Pathways of Metal Oxides: Models for Catalysis

Report about visit and future plans (max. 200 words, English):

Thanks to the BritInn Network travel and subsistence funds were awarded to DPhil candidate Ethan Cunningham allowing him to visit the laboratory of Prof. Dr. Martin Beyer. During the visit a public lecture was given by Mr Cunningham titled “Elucidating Periodic Trends in Metal-Ligand Complexes” at the Institut für Ionenphysik und Angewandte Physik. This lecture presented work from the candidate’s DPhil project, investigating fundamental binding interactions in metal-molecule complexes which represent model entrance-channel species for single-site catalysis.

The aim of the visit was to investigate the efficacy of electrospray ionization in producing charged iron-oxide species with and without organic adsorbates e.g. small hydrocarbons. The iron-oxide clusters were to be generated using an electrospray ionization source, mass selected and stored in the ion trap of a Fourier transform ion cyclotron resonance (FT-ICR) mass spectrometer, Figure 1. The candidate received full training in experimental procedure including: sample preparation, generation and optimization of ions produced *via* the electrospray ionization source, optimization of ion trap, data collection and data analysis.

Preliminary experiments proved successful; efficient production of iron oxides with attached organic adsorbates was achieved (Figure 2b). Mass-selection of specific iron-oxide complexes was also achieved (Figure 2a). The next steps will be to explore the photochemistry of these iron-oxide clusters, key findings would involve wavelength-specific (i.e. mode-selective) fragmentation/reaction pathways, including light-induced oxidation and rearrangement reactions which are relevant for tropospheric photochemistry.

The candidate is currently applying for a postdoctoral position at the University of Innsbruck, with Prof Martin Beyer and will apply for support from the Austrian Science Fund (FWF) in the Lise Meitner Programme.

Picture Credits: Ethan Cunningham



Figure 1. 9.4 Tesla FT-ICR experiment.

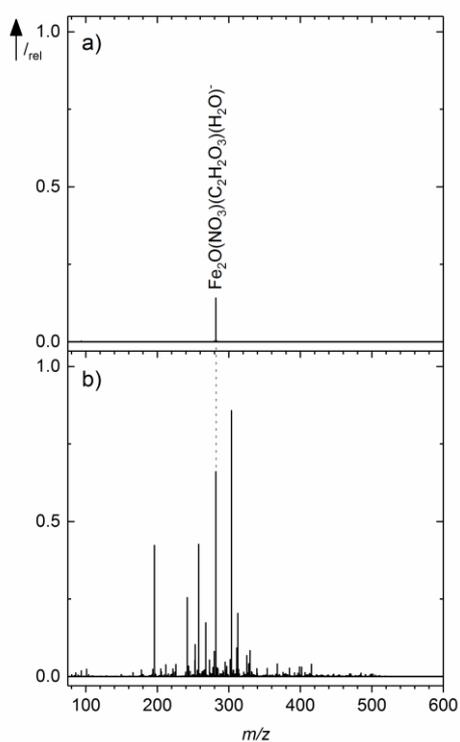


Figure 2. Mass spectra showing a) mass-selected $\text{Fe}_2\text{O}(\text{NO}_3)(\text{C}_2\text{H}_2\text{O}_3)(\text{H}_2\text{O})^-$, and b) a typical mass spectrum of a solution of FeNO_3 and $\text{C}_2\text{H}_2\text{O}_3$ in CH_3OH .



Figure 3. View of the mountains from the Institut für Ionenphysik und Angewandte Physik, Universität Innsbruck.