University of Birmingham

# Professor Helen J. Cooper PhD MRSC

Professor of Mass Spectrometry

**School of Biosciences (/schools/biosciences/index.aspx)**

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## About

Professor Helen J. Cooper is an expert in the gas-phase ion chemistry of peptides and proteins. She is a world-leader in the field of electron capture dissociation mass spectrometry and is responsible for establishing the University of Birmingham as a centre of excellence in mass spectrometry research. Professor Cooper has published extensively in peer-reviewed journals and serves on a number of national and international committees including the Editorial Board for the *Journal of the American Society for Mass Spectrometry* and the British Mass Spectrometry Society.

## Qualifications

BSc (Hons) Chemistry, University of Warwick

PhD Chemistry, University of Warwick

## Biography

Professor Helen J. Cooper obtained her BSc and PhD in Chemistry at the University of Warwick. She began her post-doctoral career at the University of Warwick, before taking a faculty position at the National High Magnetic Field Laboratory, Florida State University, in 2000. In 2003, she returned to the UK as Wellcome Trust Value-in-People Fellow at the University of Birmingham.She was subsequently awarded a Wellcome Trust University Technology Fellowship to develop high performance mass spectrometry methods for use in biomedical research. In 2010, she took up the post of Senior Lecturer.

## Teaching

Professor Cooper teaches at both undergraduate (1st, 2nd and final year) and postgraduate (MSc, MRes) level. She is committed to research-informed teaching and enquiry-based learning. She is currently undertaking the Postgraduate Certificate in Learning & Teaching in Higher Education.

## Postgraduate supervision

For a list of possible PhD projects offered by Professor Cooper **www.findaphd.com/search/customlink.asp?inst=birm-Biol&supersurname=Cooper (http://www.findaphd.com/search/customlink.asp?inst=birm-Biol&supersurname=Cooper)**

## Research

Research Theme within School of Biosciences: **Molecular and Cell Biology (/research/activity/cellbiology/index.aspx)**

Group web site: **www.biosciences-labs.bham.ac.uk/cooper (http://www.biosciences-labs.bham.ac.uk/cooper)**

### Advanced mass spectrometry techniques for the analysis of biomolecular and chemical structure

We are interested in the development and application of mass spectrometry techniques for the characterisation of biomolecular and non-biomolecular structures. Current work in the laboratory focuses on the following areas:

1. **Development of methods for proteomics** Proteomics involves the study of the entire protein complement of a cell or system. In bottom-up proteomics, proteins are digested and the resulting peptides are analysed by liquid chromatography tandem mass spectrometry. The aim is to identify, characterise and quantify the peptides and hence proteins. We are developing methods for proteomics using Fourier transform mass spectrometry together with electron capture dissociation (ECD), electron transfer dissociation (ETD) and collision induced dissociation (CID).

Thermo Fisher LTQ FT Ultra mass spectrometer

2. **Fundamentals of peptide fragmentation** Peptide fragmentation is central to the field of proteomics. Peptide fragmentation provides sequence information which in turn enables protein identification. In order to obtain as much information as possible about a peptide, it is necessary to fully understand the mechanisms by which it fragments in the mass spectrometer. We apply a model peptide approach to investigate the fundamentals of peptide fragmentation. We are particularly interested in the mechanisms of electron capture/transfer dissociation.

3. **Analysis of post-translational modifications** Structural elucidation of post-translationally modified peptides and proteins is of key importance in the understanding of an array of biological processes. For example, protein phosphorylation is a key event in signal transduction. Full insight into signalling processes requires identification of modified proteins and determination of the exact sites of modification. Modifications studied include phosphorylation, ubiquitination, nitration, glycosylation and citrullination.

Thermo Fisher Orbitrap Velos ETD with FAIMS

4. **Ion mobility spectrometry and mass spectrometry** Post-translational modifications alter local interactions and hence the overall structure of a protein. Ion mobility spectrometry separates ions on the basis of their shape (and charge) whereas mass spectrometry separates ions on the basis of their mass (and charge). We are developing methods which exploit ion mobility for the analysis of post-translational modifications.

5. **Direct surface sampling of dried blood spots** In collaboration with Birmingham Children's Hospital, we are developing mass spectrometry-based methods for the diagnosis of inherited disorders in newborns.

## Publications


'Dissociation techniques in mass spectrometry-based proteomics'
Jones, A.W.; Cooper, H.J.
The Analyst, 2011, in press.

'Manipulation of quorum sensing regulation in Pseudomonas fluorescens NCIMB 10586 to increase mupirocin production'
Hothersall, J.; Murphy, A.C.; Iqbal,, Z., Campbell, G.; Stephens, E.R.; Wu, J.; Cooper, H.J.; Atkinson, S.; Williams, P.; Crosby, J.; Willis, C.L.; Cox, R.J.; Simpson, T.J.; Thomas, C.M.
Appl. Microbiol. Biotech., 2011, in press

'Haemoglobin variant analysis (HbS, HbC and HbD) via direct surface sampling of dried blood spots coupled with high resolution mass spectrometry'
Edwards, R.L.; Creese, A.J.; Baumert, M.; Griffiths, P.; Bunch, J.; Cooper, H.J.
Anal. Chem., 2011, 83, 2265-2270.

'Novel glycosylation sites localized in Campylobacter jejuni flagellin FlaA by liquid chromatography electron capture dissociation tandem mass spectrometry'
Zampronio, C.G.; Blackwell, G.; Penn, C.W.; Cooper, H.J.
J. Proteome Res., 2011, 10, 1238-1245.

'Complete separation of peptide isomers with variant modified sites by high-resolution differential ion mobility spectrometry' Shvartsburg, A.A.; Creese, A.J.; Smith, R.D.; Cooper, H.J. *Anal. Chem.,* 2010, 82, 8327-8334.

'On-line liquid chromatography neutral loss-triggered electron transfer dissociation mass spectrometry for the targeted analysis of citrullinated peptides' Creese, A.J.; Grant, M.M.; Chapple, I.L.C.; Cooper, H.J. *Anal. Methods,* 2011, 3, 259-266.

'Electron induced dissociation (EID) tandem mass spectrometry of octaethylporphyrin and its iron (III) complex' Kaczorowska, M.A.; Cooper, H.J. *Chem. Commun.,* 2011, 47, 418-420.

'Probing the mechanisms of electron capture dissociation mass spectrometry with nitrated peptides' Jones, A.W.; Cooper, H.J. *Phys. Chem. Chem. Phys.,* 2010, 12, 13394-13399.

'Proteomic analysis of a non-invasive human model of acute inflammation and its resolution: the 21 day gingivitis model' Grant, M.M.; Creese, A.J.; Barr, G.; Ling, M.; Matthews, J.B.; Griffiths, H.R.; Cooper, H.J.; Chapple, I.L.C. *J. Proteome Res.,* 2010, 9, 4732-4744.

'Top-Down Mass Analysis of Protein Tyrosine Nitration: Comparison of Electron Capture Dissociation with 'Slow-Heating' Tandem Mass Spectrometry Methods' Mikhailov, V.A.; Iniesta, J.; Cooper, H.J. *Anal. Chem.,* 2010, 82, 7283-7292.

'Nitration of lysozyme by ultrasonic waves: Demonstration by immunochemistry and mass spectrometry' Dean, S.; Cox, M.; Heptinstall, J.; Walton, D.J.; Mikhailov, V.A.; Cooper, H.J.; Gomez-Mingot, M.; Iniesta, J. *Ultrasonics Sonochemistry*, 2011, 18, 334-344.

'Can museum egg specimens be used for proteomic analyses?' Portugal, S.J.; Cooper, H.J.; Zampronio, C.G.; Wallace, L.L.; Cassey, P. *Proteome Science,* 2010, 8, 40.

'Electron induced dissociation: A mass spectrometry technique for the structural analysis of trinuclear oxo-centred carboxylate-bridged iron complexes' Kaczorowska, M.A.; Cooper, H.J. *J. Am. Soc. Mass Spectrom.,* 2010, 21, 1398-1403.

'Differential phosphoproteomics of fibroblast growth factor signalling: Identification of Src family kinase-mediated phosphorylation events' Cunningham, D.L.; Sweet, S.M.M.; Cooper, H.J.; Heath, J.K. *J. Proteome Res.,* 2010, 9, 2317-2328.

'Retention of enzyme activity with a boron doped diamond electrode in the electro-oxidative nitration of lysozyme' Iniesta, J.; Deseada Esclapez-Vicente, M.; Heptinstall, J.; Walton, D.J.; Peterson, I.R.; Mikhailov, V.A.; Cooper, H.J. *Enzyme and Microbial Technology* ,2010, 46, 472-478.

'Electron capture dissociation mass spectrometry of metallo-supramolecular complexes' Kaczorowska, M.A.; Hotze, A.C.G.; Hannon, M.J.; Cooper, H.J. *J. Am. Soc. Mass Spectrom.,* 2010, 21, 300-309.

'Electron capture dissociation mass spectrometry of tyrosine nitrated peptides' Jones, A.W.; Mikhailov, V.A.; Iniesta, J.; Cooper, H.J. *J. Am. Soc. Mass Spectrom.,* 2010, 21, 268-277.

'Database search strategies for proteomic datasets generated by electron capture dissociation mass spectrometry' Sweet, S.M.M.; Jones, A.W.; Cunningham, D.L.; Heath, J.K.; Creese, A.J.; Cooper, H.J. *J. Proteome Res.,* 2009, 8, 5475-5484.

'Characterization of polyphosphoesters by Fourier transform ion cyclotron resonance mass spectrometry' Kaczorowska, M.A.; Cooper, H.J. *J. Am. Mass Spectrom.,* 2009, 20, 2238-2247.

'Hot electron capture dissociation distinguishes leucine from isoleucine in a novel hemoglobin variant, Hb Askew, β54(D5)Val®Ile' Williams, J.P.; Creese, A.J.; Roper, D.R.; Green, B. N.; Cooper, H.J. *J. Am. Soc. Mass Spectrom.* 2009, 20, 1707-1713.

'High field asymmetric waveform ion mobility spectrometry (FAIMS) coupled with high resolution electron transfer dissociation mass spectrometry for the analysis of isobaric phosphopeptides' Xuan, Y.; Creese, A.J.; Horner, J.A.; Cooper, H.J. *Rapid Commun. Mass Spectrom.,* 2009, 23, 1963-1969.

'Large-scale localization of protein phosphorylation by electron capture dissociation mass spectrometry' Sweet, S.M.M.; Bailey, C.M.; Cunningham, D.L.; Heath, J.K.; Cooper, H.J. *Mol. Cell. Proteomics,* 2009, 8, 904-912.

'SLoMo: Automated site localisation of modifications from ETD/ECD mass spectra' Bailey, C.M., Sweet, S.M.M., Cunningham, D.L., Zeller, M., Heath, J.K., Cooper, H.J. *J. Proteome Res.,* 2009, 8, 1965-1971.

'Activated ion electron capture dissociation (AI ECD) of proteins: Synchronization of infrared and electron irradiation with ion magnetron motion' Mikhailov, V.A.; Cooper, H.J. *J. Am. Soc. Mass Spectrom.* 2009, 20, 763-771.

'Electron capture dissociation and collision-induced dissociation of metal ion ($Ag^{+}$, $Cu^{2+}$, $Zn^{2+}$, $Fe^{2+}$ and $Fe^{3+}$) complexes of polyamidoamine (PAMAM) dendrimers' Kaczorowska, M.A.; Cooper, H.J. *J. Am. Soc. Mass Spectrom.,* 2009, 20, 674-681.

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‘The effect of phosphorylation on the electron capture dissociation of peptide ions’ Creese, A.J.; Cooper, H.J. *J. Am. Soc. Mass Spectrom.,*2008, 19, 1263-1274.

‘Specific electrochemical iodination of horse heart myoglobin as determined by Fourier transform ion cyclotron resonance mass spectrometry’ Iniesta, J.; Cooper, H.J.; Marshall, A.G.; Heptinstall, J.; Walton, D.J.; Peterson, I.R. *Arch. Biophys. Biochem.,* 2008, 474, 1-7.

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‘Mass spectrometry in demonstrating the site-specific nitration of hen egg white lysozyme by an improved electrochemical method’ Matters, D.; Cooper, H.J.; McDonnell, L.; Iniesta, J.; Heptinstall, J.; Derrick, P.J.; Walton, D.; Peterson, I.R, *Anal. Biochem.*, 2006, 356, 171-181.

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