Dr Naresh Kumar CPhys MInstP MRSC

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Research Work Experience

Aug 2020-Present	**Senior Scientist & Lecturer** in the Lab of Organic Chemistry, Department of Chemistry and Applied Biosciences, ETH Zurich, Switzerland
Oct 2020-Present	**Visiting Professor** at the School of Sciences, Hangzhou Dianzi University, China
Apr 2017-Jul 2020	**Higher Research Scientist** in the Surface Technology Group, Department of Chemistry and Biological Sciences, National Physical Laboratory (NPL), UK
Oct 2011-Mar 2017	**Research Scientist** in the Surface Technology Group, Department of Chemistry and Biological Sciences, National Physical Laboratory, UK

Teaching Experience

- **Principle Lecturer**, Nanoscale Molecular Imaging, Spring Semester (2022, 2023) ETH Zurich
- **Lecturer**, Spectra Interpretation of Organic Compounds, Spring Semester (2021-2023) ETH Zurich

Academic Qualifications

- 2015-2018: **PhD** from Department of Chemistry, Utrecht University, Netherlands
  - Thesis title: Development of tip-enhanced Raman spectroscopy and its application to heterogeneous catalysis research. Thesis supervisor: Prof. Bert Weckhuysen
- 2010-2011: **Master of Research in Physics at the Nanoscale** with distinction from Department of Physics, King's College London
  - Thesis title: Nanoscale chemical characterisation using tip-enhanced Raman spectroscopy. Thesis supervisor: Prof. David Richards
- 2006-2010: **Bachelor of Technology in Engineering Physics** from Department of Physics, Indian Institute of Technology Delhi
  - Thesis title: Deposition and characterisation of silver nanoparticles on patterned silicon/glass substrates. Thesis supervisor: Prof. J. P. Singh
- 2005-2007: **Bachelor of Science in Economics** with 1st class honours from London School of Economics

Professional Memberships

- Member, Swiss Chemical Society 2022 - Present
- Member, International Society for Optics and Photonics (SPIE), USA 2022 - Present
- Member (MRSC), Royal Society of Chemistry 2017 - Present
- Member (MInstP), Institute of Physics 2017 – Present

Awards & Honours

- Masao Horiba Award for advancement of optical nanospectroscopy for high-resolution chemical characterization of novel semiconductor materials, HORIBA Ltd., Japan (2023)
- Chartered Physicist (CPhys) Award from the Institute of Physics, UK (2017)
- Rayleigh Early Career Award by the National Physical Laboratory, UK (2016)
- Distinguished Paper Award at the International Conference on Tip-enhanced Raman Spectroscopy, Osaka, Japan (2015)
- Award of Academic Excellence by the University of London, UK (2005)

Publications

ORCID | Google Scholar

Total citations: 1558, h-index: 20, i10-index: 27

Peer-reviewed scientific papers

1. Y. Pandey, D. F. Abbott, V. Mougel, **N. Kumar***, R. Zenobi* "Probing the Role of Environmental and Sample Characteristics in Gap Mode Tip-Enhanced Raman Spectroscopycall_made" Analytical Chemistry, 2023, 95, 23, 8869–8878
2. D. Mrđenović, Z-.X. Tang, Y. Pandey, W. Su, Y. Zhang, **N. Kumar***, R. Zenobi "Regioselective Tip-Enhanced Raman Spectroscopy of Lipid Membranes with Sub-Nanometer Axial Resolution" *Nano Letters,* 2023, 23, 9, 3939–3946
3. K. R. Paton, K. Despotelis, **N. Kumar**, P. Turner, A. J. Pollard "On the use of Raman spectroscopy to characterize mass-produced graphene nanoplatelets" *Beilstein Journal of Nanotechnology*, 2023, 14 (1), 509-521
4. D. Mrđenović, Z.-F. Cai, Y. Pandey, G. L. Bartolomeo, R. Zenobi*, **N. Kumar*** "Nanoscale chemical analysis of 2D molecular materials using tip-enhanced Raman spectroscopy" *Nanoscale*, 2023, 15, 963-974
5. Z.-F. Cai, **N. Kumar**, R. Zenobi, "Probing On-Surface Chemistry at the Nanoscale Using Tip-Enhanced Raman Spectroscopy" *CCS Chemistry*, 2023, 5, 55-71
6. S. Bienz, S. H. van Vreeswijk, Y. Pandey, G. Bartolomeo, B. M. Weckhuysen, R. Zenobi*, **N. Kumar*** "Probing coke formation during the methanol-to-hydrocarbon reaction on zeolite ZSM-5 catalyst at the nanoscale using tip-enhanced fluorescence microscopy" *Catalysis Science & Technology* 2022, 12, 5795-5801
7. Z.-F. Cai, J. P. Merino, W. Fang, **N. Kumar***, J. O. Richardson, S. D. Feyter, R. Zenobi* "Molecular-Level Insights on Reactive Arrangement in On-Surface Photocatalytic Coupling Reactions Using Tip-Enhanced Raman Spectroscopy" *Journal of the American Chemical Society*, 2022, 144, 538−546
8. D. Mrđenović, W. Ge, **N. Kumar***, R. Zenobi* "Nanoscale Chemical Imaging of Human Cell Membranes Using Tip-Enhanced Raman Spectroscopy" Angewandte Chemie International Edition 2022, 61, e2022102
9. D. Mrđenović, D. Abbott, V. Mougel, W. Su, **N. Kumar***, R. Zenobi* "Visualizing Surface Phase Separation in PS-PMMA Polymer Blends at the Nanoscale" *ACS Applied Material & Interfaces* 2022, 14, 24938–24945
10. Z.-F. Cai, T. Käser, **N. Kumar**, R. Zenobi "Visualizing On-Surface Decomposition Chemistry at the Nanoscale Using Tip-Enhanced Raman Spectroscopy" *Journal of Physical Chemistry Letters* 2022, 13, 22, 4864–4870
11. J. Shao, F. Chen, W. Su, **N. Kumar**, Y. Zeng, L. Wu, H.-W. Lu "Probing Nanoscale Exciton Funneling at Wrinkles of Twisted Bilayer MoS2 Using Tip-Enhanced Photoluminescence Microscopy" *Journal of Physical Chemistry Letters* 2022, 13, 14, 3304–3309
12. G. L. Bartolomeo, Y. Zhang, **N. Kumar***, R. Zenobi* "Molecular Perturbation Effects in AFM-Based Tip-Enhanced Raman Spectroscopy: Contact versus Tapping Mode" *Analytical Chemistry*, 2021, 93(46), 15358-15364
13. W. Su*, **N. Kumar***, H. Shu, O. Lancry, M. Chaigneau "In situ Visualization of Optoelectronic Behavior of Grain Boundaries in Monolayer WSe2 at the Nanoscale" *The Journal of Physical Chemistry C*, 2021, 125(48), 26883-26891
14. Y. Pandey, **N. Kumar***, G. Goubert, R. Zenobi* "Nanoscale Chemical Imaging of Supported Lipid Monolayers using Tip-Enhanced Raman Spectroscopy" *Angewandte Chemie* 2021, 133, 19189-19194

15. W. Su*, A. Esfandiar, O. Lancry, J. Shao, **N. Kumar***, M. Chaigneau* "Visualising structural modification of patterned graphene nanoribbons using tip-enhanced Raman spectroscopy" *Chemical Communications*, 2021, 57, 6895-6898
16. **N. Kumar**, S. Marchesini, T. Howe, L. Edwards, B. Brennan, A. J. Pollard "Nanoscale characterization of plasma functionalized graphitic flakes using tip-enhanced Raman spectroscopy" *The Journal of Chemical Physics,* 2020, 153, 184708
17. M. Race, A. Rae, J.-L. Vorng, R. Havelund, A. Dexter, **N. Kumar** *et al.* "Correlative Hyperspectral Imaging Using a Dimensionality-Reduction-Based Image Fusion Method" *Analytical Chemistry,* 2020, 92, 10979-10988
18. E. L. Legge, K. R. Paton, M. Wywijas, G. McMahon, R. Pemberton, **N. Kumar** *et al.* "Determining the level and location of functional groups on few-layer graphene and their effect on the mechanical properties of nanocomposites" *ACS Applied Materials & Interfaces*, 2020, 12(11), 13481-13493
19. **N. Kumar**, B. M. Weckhuysen, A. J. Wain, A. J. Pollard "Nanoscale chemical imaging using tip-enhanced Raman spectroscopy" ***Nature Protocols*** 2019, 14, 1169-1193
20. **N. Kumar†**, C. S. Wondergem**†**, A. J. Wain, B. M. Weckhuysen "Towards in situ nanoscale mapping of catalytic reactions in liquid phase using tip-enhanced Raman spectroscopy" *The Journal of Physical Chemistry Letters* 2019,10, 1669-1675 **(†Equal contribution)**
21. **N. Kumar**, S. Kalirai, A. J. Wain and B. M. Weckhuysen "Nanoscale chemical imaging of a single catalyst particle with tip-enhanced fluorescence microscopy" *ChemCatChem* 2019, 11, 417-423
22. W. Su**†***, **N. Kumar†***, A. Krayev, M. Chaigneau* "In situ topographical chemical and electrical imaging of carboxyl graphene oxide at the nanoscale" ***Nature Communications*** 2018, 9: 2891 **(†Equal contribution)**
23. **N. Kumar***, W. Su, F. A. Castro, B. M. Weckhuysen "Applications of Tip-enhanced Raman Spectroscopy: From Graphene to Catalysis" *Nanoimaging and Nanospectroscopy* 2018, 10726, 1072608
24. **N. Kumar**, W. Su, M. Veselý, B. M. Weckhuysen, A. J. Pollard, A. J. Wain "Nanoscale chemical imaging of solid-liquid interfaces using tip-enhanced Raman spectroscopy" *Nanoscale*, 2018, 10, 1815 - 1824
25. **N. Kumar*,** A. Zoladek-Lemanczyk, A. Gilbert, S. M. Tuladhar, T. Kirchartz, B. C. Schroeder, I. McCulloch, J. Nelson, D. Roy, F. A. Castro* "Simultaneous topographical, electrical and optical microscopy of optoelectronic devices at the nanoscale" *Nanoscale,* 2017, 9, 2723-2731
26. **N. Kumar***, M. M. Drozdz, H. Jiang, D. M. Santos, D. J. Vaux "Nanoscale mapping of newly-synthesised phospholipid molecules in a biological cell using tip-enhanced Raman spectroscopy" *Chemical Communications*, 2017, 53 (16), 2451-2454
27. **N. Kumar*** and F. A. Castro "Molecular mapping beyond the diffraction limit using tip-enhanced optical spectroscopy" *Imaging & Microscopy* 2017, 3, 34 – 36
28. W. Su**†**, **N. Kumar†**, S. Mignuzzi, J. Crain, D. Roy "Nanoscale mapping of excitonic processes in single layer MoS_2 using tip-enhanced photoluminescence microscopy" *Nanoscale* 2016, 8, 10564-10569 **(†Equal contribution)**
29. W. Su**†**, **N. Kumar†**, N. Dai, D. Roy "Nanoscale chemical mapping of intrinsic defects in graphene using tip-enhanced Raman spectroscopy" *Chemical Communications* 2016, 52, 8227-8230 **(†Equal contribution)**
30. **N. Kumar***, S. J. Spencer, A. J. Wain, D. Imbraguglio, A. Rossi, B. M. Weckhuysen, D. Roy*, "Extending the plasmonic lifetime of tip-enhanced Raman spectroscopy probes" *Physical Chemistry Chemical Physics* 2016, 18, 13710-13716
31. T. Hartman, C. S. Wondergem, **N. Kumar**, A. Berg, B. M. Weckhuysen "Surface- and tip-enhanced Raman spectroscopy in catalysis" *The Journal of Physical Chemistry Letters* 2016, 7, 1570-1584

32. **N. Kumar**, B. Stephanidis, R. Zenobi, A. J. Wain, D. Roy "Nanoscale mapping of catalytic activity using tip-enhanced Raman spectroscopy" *Nanoscal*e 2015, 7, 7133–7137
33. S. Mignuzzi, **N. Kumar**, B. Brennan, I. S. Gilmore, D. R. Richards, A. J. Pollard, D. Roy "Probing individual point defects in graphene via near-field Raman scattering" *Nanoscale* 2015, 9, 19413-19418
34. W. Su, **N. Kumar**, S. J. Spencer, N. Dai, D. Roy "Transforming bilayer MoS_2 into single-layer with strong photoluminescence using UV-ozone oxidation" *Nano Research* 2015, 8(12), 3878-3886
35. **N. Kumar**, S. Mignuzzi, W. Su, D. Roy "Tip-enhanced Raman spectroscopy: Principles and applications" *European Physical Journal Techniques and Instrumentation* 2015, 2(1), 9
36. **N. Kumar**, A. Rae, D. Roy "Accurate measurement of enhancement factor in tip-enhanced Raman spectroscopy through elimination of far-field artefacts" *Applied Physics Letters* 2014, 104, 123106
37. C. Blum, L. Opilik, J. M. Atkin, K. Braun, S. B. Kämmer, V. Kravtsov, **N. Kumar** *et al.* "Tip-enhanced Raman spectroscopy–an interlaboratory reproducibility and comparison study" *Journal of Raman Spectroscopy* 2014, 45 (1), 22-31
38. J. Pollard, **N. Kumar**, A. Rae, S. Mignuzzi, W. Su, D. Roy "Nanoscale spectroscopy: An emerging tool for the characterisation of 2-D materials" *Journal of Material Nanoscience* 2014, 1(1) 39-49
39. M. Hirtz, **N. Kumar**, L. Chi "Simulation modelling of supported lipid membranes - A review" *Current Topics in Medicinal Chemistry* 2014, 14 (5), 617-623
40. M. Hirtz, **N. Kumar**, J. H. Franke, J. Hao, N. Lu, H. Fuchs, L. Chi "Selective deposition of organic molecules onto DPPC templates–A molecular dynamics study" *Journals of Colloid Interface Science* 2013, 389 (1), 206-212

Book chapter

41. A. Krayev, J. F. Schultz, N. Jiang, S. Goswami, A. Tempez, S. Ambardar, D. V. Voronine, **N. Kumar** et al. "Near-Field Nanospectroscopy and Tip-Enhanced Raman Spectroscopy (TERS)" in *Nanoscopy and Nanospectroscopy*, CRC Press, Boca Raton, 2023, 131-252
42. **N. Kumar*** "Nanoscale chemical characterisation of peptides and proteins using tip-enhanced Raman spectroscopy" in *Amino Acids, Peptides and Proteins: Volume 43*, The Royal Society of Chemistry, UK, 2019, 43, 127-153

International Conference Presentations & Invited Seminars

- "Non-destructive and label free chemical analysis using Raman spectroscopy at the micro and nanoscales", Hangzhou Dianzi University, Hangzhou, China, Oct 2023 – **Invited Seminar**
- "Non-destructive and label free chemical analysis using Raman spectroscopy at the micro and nanoscales", Conference on Applied Surface and Solid Material Analysis 2023, ETH Zurich, Switzerland, Sep 2023 – **Invited**
- "Label-free Analysis of Biological Membranes at the Nanoscale using Tip enhanced Raman Spectroscopy", Enhanced Nanospectroscopy and Nanoimaging 2023, San Diego, USA, Aug 2023 – **Invited**
- "Label-Free Nanoanalysis of Biomembranes using Tip Enhanced Raman Spectroscopy", University of Illinois at Chicago, USA, Aug 2023 – **Invited Seminar**
- "Nanoscale Investigation of Heterogenous Catalytic Processes using Tip-Enhanced Raman Spectroscopy", Euroanalysis 2023, Geneva, Switzerland, Aug 2023
- "Nanoscale Investigation of Surface Catalytic Processes using Tip-Enhanced Raman Spectroscopy", Raman Workshop 2023, ETH Zurich, Switzerland, Jun 2023 - **Invited**
- "Label-free Biomolecular Analysis at the Nanoscale using Tip enhanced Raman Spectroscopy", Anakon 2023, Vienna, Austria, Apr 2023 - **Keynote**

- "Surface Molecular Analysis at the Nanoscale using Tip-Enhanced Raman Spectroscopy", CHanalysis 2023, Beatenberg, Switzerland, Mar 2023
- "Nanoscale Chemical Analysis using STM-based Tip-enhanced Raman Spectroscopy", Max Plank Institute Stuttgart, Germany, Jan 2023 – **Invited Seminar**
- "Nanoscale chemical imaging of 2D materials using tip-enhanced optical spectroscopy" 8th International Conference on Tip-Enhanced Raman Spectroscopy, Paris, France, Nov 2022 - **Keynote**
- "Visualizing Surface Phase Separation in PS-PMMA Polymer Blends at the Nanoscale using TERS" 9th International Conference on Advanced Applied Raman Spectroscopy, Paris, France, Sep 2022 - **Invited**
- "Molecular-level insights on reactive arrangement in on-surface photocatalytic coupling reactions" Enhanced Spectroscopies and Nanoimaging 2022, San Diego, USA, Aug 2022 - **Invited**
- "TERS protocol for Nanoscale Chemical Imaging of Commercial Functionalized Few-layer Graphene" 27th International Conference for Raman Spectroscopy, Long Beach, USA, Aug 2022
- "Nanoscale chemical imaging of 2D materials using tip-enhanced optical spectroscopy", University of Chemistry and Technology, Prague, Czech Republic, Apr 2022 - **Invited Seminar**
- "Nanoscale chemical imaging using TERS: Application to biological, catalytic & 2D materials", ETH Zurich, Switzerland, May 2020 - **Invited Seminar**
- "TERS Imaging of Commercial Functionalized Multi-layer Graphene," The 7th International Conference On Tip-Enhanced Raman Spectroscopy, Xiamen University, China, Nov 2019
- "Applications of plasmon-enhanced optical nanospectroscopy in catalysis, organic electronics and 2D materials," University of Nottingham, UK, Oct 2019 – **Invited Seminar**
- "Principles and applications of plasmon-enhanced optical nanospectroscopy," Hangzhou Dianzi University, China, Oct 2019 – **Invited Seminar**
- "Nanoscale molecular imaging using tip-enhanced Raman spectroscopy," Sharp Meets Bright Workshop, Columbia University, New York, USA, Sep 2019 – **Invited**
- "Molecular Imaging beyond diffraction limit using tip-enhanced Raman spectroscopy," International Conference on Advanced Applied Raman Spectroscopy (RamanFest 2019), University of Oxford, UK, Jun 2019 – **Invited**
- "Nanoscale chemical imaging of phospholipid molecules in a biological cell using tip-enhanced Raman spectroscopy," Bioimaging Symposium, University of Southampton, UK, Jan 2019 – **Invited**
- "Molecular mapping beyond diffraction limit using tip-enhanced Raman spectroscopy," Nanospectroscopy and Nanoimaging symposium 2018, SPIE, San Diego, USA, Aug 2018 – **Invited**
- "Nanoscale chemical imaging of solid-liquid interfaces using tip-enhanced Raman spectroscopy," 26th International conference in Raman spectroscopy, Jeju, Korea, Aug 2018
- "Molecular mapping beyond diffraction limit using tip-enhanced Raman spectroscopy," Raman Workshop 2018, ETH Zurich, Switzerland, Jun 2018 – **Invited**
- "Nanoscale chemical mapping using tip-enhanced Raman spectroscopy," SciX Spring 2018 meeting, Glasgow, UK, Apr 2018 – Poster presentation
- "Application of tip-enhanced optical spectroscopy in nanoscale characterisation of catalytic activity," 13th European Congress on Catalysis, Aug 2017, Florence, Italy
- "Nanoscale mapping of catalytic activity using tip-enhanced Raman spectroscopy," North American Catalysis Society Meeting, Denver, USA. Jun 2017
- "Simultaneous topographical, chemical and electrical surface imaging at the nanoscale," European Material Research Society Spring Meeting, Strasbourg, France, May 2017 – **Invited**
- "Visualising surface chemistry beyond diffraction limit using tip-enhanced Raman spectroscopy," Chemnitz University of Technology, Germany, Feb 2017 – **Invited Seminar**
- "Nanoscale mapping of activity in heterogeneous catalysts using tip-enhanced optical spectroscopy," UK Catalysis Conference, Loughborough, UK, Jan 2017 – **Keynote**

- "Extending the plasmonic lifetime of tip-enhanced Raman spectroscopy probes," 25th International conference in Raman spectroscopy, Fortaleza, Brazil, Aug 2016
- "Nanoscale mapping of catalytic activity using tip-enhanced Raman spectroscopy," 5th International Conference on Tip-Enhanced Raman Spectroscopy, Osaka, Japan, Oct 2015
- "Accurate measurement of enhancement factor in tip-enhanced Raman spectroscopy," 24th International conference in Raman spectroscopy, Jena, Germany, Aug 2014
- "Tip-enhanced Raman spectroscopy: Principles & applications," Karlsruhe Institute of Technology, Karlsruhe, Germany, Aug 2013 – **Invited Seminar**