

Anton Tamtögl

Fasangasse 25
8075 Hart bei Graz
Austria

+43 680 3171626

tamtogl@tugraz.at

www.tugraz.at/institutes/
iep/research/surfaces/

0000-0001-9590-6224

Education

Habilitation

higher-education teaching qualification
in *Experimental Physics*

Energy dissipation on Dirac and semimetal surfaces, Graz University of Technology

Apr 2021 | Graz, Austria

PhD in Physics

graduation with distinction (highest possible grade)

PhD thesis: *Surface Dynamics and Structure of Bi(111) from Helium Atom Scattering*

Jun 2012 | Graz, Austria

Master's degree in Technical Physics

graduation with distinction

master's thesis: *Adsorption and Desorption Processes on Clean and Zn-modified Pd(111)*

Jun 2008 | Graz, Austria

Study stay at University of Strathclyde

Jan 06 – Jun 06 | Glasgow, UK

Apprenticeship training

as electronics technician and electrician

Apprenticeship examination in both professions

Sep 00 – Jul 01 | Austria

Languages

German: mother tongue

English: proficient user (C2)

Spanish: basic user (A1)

Computer Skills

MATLAB, Python, C++

Autodesk Inventor, SPS(LabView)

Publishing software (LaTeX, InDesign)

Mathematica, Office

Operating systems (Windows, Linux)

Experience

Sep 2021 - Present **PI and R&T-House, Graz University of Technology**

- Support for other researchers' in proposal writing and administration at the Research&Technology (R&T) House
- PI of an FWF project

2017 - Jul 2021 **Senior Researcher, Graz University of Technology**

- Research lead, lecturing of full courses and supervision
- **Habilitation** in *Experimental Physics* with 03/21
- First measurement of water diffusion at a surface based on scattering - first authored **Nature communications** features in **top 5%** of all scientific articles (according to **altmetric**)
- Organisation of an online **summer school**
- Interdisciplinary **publications**
- Several large scale facility measurements

2016 **Research Fellow, Graz University of Technology**

- Extended collaboration and supervision of master students
- Development of further simulation methods in MATLAB & Simulink based on **Monte-Carlo** and Molecular Dynamics approaches
- Further improvements and developments of the machines both in Cambridge (control system running on a microcontroller, published in **Rev. Sci. Instr.**) and Graz (including *in-situ* sample preparation and **sample transfer**)

2014 - 2015 **Research Fellow, University of Cambridge**

- Initiated a close collaboration with Aarhus University / **Centre of Excellence for Dirac Materials** (world-leading group for the growth of **topological** and two-dimensional materials)
- Pioneered e-ph coupling approach for **topological insulators**
- Experimental studies of molecular motion at surfaces, e.g.:
 - First unequivocal proof of motion in the **ballistic regime**
 - Hydrogenation of a **graphene surface**
- Faster data acquisition via implementation of new findings in image reconstruction & **compressed sensing** (interdisciplinary collaboration with department of mathematics)

Jul 2012 - Sep 2013 **Research Associate, Graz University of Technology**

- Initiation of a collaboration with theorists and demonstrating the ability of the experimental method to quantify the electron-phonon (e-ph) **coupling strength**
- Modelling of **scattering intensities** with Python

Aug 2008 - Jun 2012 **PhD, Graz University of Technology** Supervisor: Prof. W. E. Ernst

- Construction and setup of a unique apparatus to study the structure & dynamics of surfaces
- First characterisation of the apparatus, designing a control system for automated measurements & monitoring
- Modelling surface properties & scattering intensities using MATLAB
- Extension of the method to **new materials**

Mar 2007 - Jun 2008 **MSc, Graz University of Technology** Supervisor: Prof. A. Winkler

- Introduction to professional research in surface science
 - Ultrahigh vacuum & surface spectroscopic techniques
 - **Interaction with gases** in the context of catalysis
 - Preparation, structure, stability & kinetics of **ultra-thin films**

Jul 2007 - Sep 2007 **Study and research stay at DESY** **German electron-synchrotron**

- Supervisor: Prof. G. Grindhammer. Analysis & reconstruction of jets (Narrow cones of hadrons/particles after high-energy collisions), Implementation of a jet finding algorithm in C++

Publications and dissemination

Scientific publications

- 37 articles published in international peer-reviewed journals (see appendix)
- 9 invited talks and numerous conference contributions (see appendix)

Outreach

- 2020 (Austrian) Long Night of Research
- 2019 Current research (elective subject at the end of secondary school)
- 2015 Physics at work (demonstration of an STM to school students)
- 2014 Cambridge science festival

Refereeing

for Phys. Rev. Lett., Phys. Rev. A & B, 2D Materials, Phys. Chem. Chem. Phys., Surf. Sci., Ann. Phys., Res. in Phys.

Funding and awards

- 2021 FWF (Austrian science fund) stand-alone project P 34704 (€ 404 057)
- 2016–2021: 7 accepted neutron beamtime proposals at about € 6000 per day, ranging from 5-10 days at the [Institut Laue-Langevin](#) (Grenoble) and [FRM II](#) (TU Munich)
- 2018: TU Graz competitive initial funding program (€ 10000)
- 2013–2016: Erwin Schrödinger research fellowship by the FWF (€ 152670)
- 2003–2005: Merit grant for exceptional achievements from the faculty of natural sciences (TU Graz)

Teaching and further training

Teaching and supervision of students

See teaching directory in the appendix for full list of courses I have taught and students I have supervised

- Surface Dynamics at the Nanoscale (TU Graz, 2018-2021)
- Special Topics of Technical Physics: Molecules of Interest (TU Graz, 2018)
- Introduction to Surface Physics (University of Cambridge, 2015)
- Calculus in Experimental Physics 2 (Electricity, Optics) (TU Graz, 2013)
- Physics for Geomatics Engineering (TU Graz, 2012)
- Calculus in Physics (TU Graz, 2009)

Continuing education

- Introduction to Lecturing (Rob Wallach, University of Cambridge, 2015)
- Psychology of Leadership and Motivation: Fundamentals (2017)
- Leading and Delegating (2017)
- Teaching in English: Introduction (2017)
- Teaching in English: Presenting in Class (2017)
- Leading Diverse Teams (2017)
- TU Graz Management development program (2019)
- Teach, Present, Publish (program by Montclair State University at TU Graz, 2019)
- Intercultural Communication (2021)
- Gender and Diversity Competencies for Scientists (2021-22)

Academic service & conference organisations

- 2010–2011 head of the students' union for doctoral studies
- Organisation committee of the ICPS2010 (International conference of physics students)
- 2006–2007 elected students' representative and head of the students' union for physics
- Long-term member of the students' union

Interests

- Music (incl. playing guitar/drums/singing & making music in a band)
- Sports (soccer, skiing, hiking), cinema
- Organisation of a yearly [music festival](#) in southeastern Styria

A Appendix

A.1. List of (selected) publications and talks

A.1.1. Publications

1. Sacchi, M. & Tamtögl, A. Water adsorption and dynamics on graphene and other 2D materials: Computational and experimental advances. *Adv. Phys.: X* **8**, 2134051 (2023).
2. Ruckhofer, A., Sacchi, M., Payne, A. J. R. J. R., Jardine, A. P., Ernst, W. E., Avidor, N. & Tamtögl, A. Evolution of ordered nanoporous phases during h-BN growth: Controlling the route from gas-phase precursor to 2D material by *in-situ* monitoring. *Nanoscale Horiz.* **7**, 1388–1396 (11 2022).
3. Schmutzler, S. J., Ruckhofer, A., Ernst, W. E. & Tamtögl, A. Surface electronic corrugation of a one-dimensional topological metal: Bi(114). *Phys. Chem. Chem. Phys.* **24**, 9146–9155 (16 2022).
4. Tamtögl, A., Bahn, E., Sacchi, M., Zhu, J., Ward, D. J., Jardine, A. P., Jenkins, S. J., Fouquet, P., Ellis, J. & Allison, W. Motion of water monomers reveals a kinetic barrier to ice nucleation on graphene. *Nat. Commun.* **12**, 3120 (2021).
5. Holst, B., Alexandrowicz, G., Avidor, N., Benedek, G., Bracco, G., Ernst, W. E., Farías, D., Jardine, A. P., Lefmann, K., Manson, J. R., Marquardt, R., Artés, S. M., Sibener, S. J., Wells, J. W., Tamtögl, A. & Allison, W. Material properties particularly suited to be measured with helium scattering: selected examples from 2D materials, van der Waals heterostructures, glassy materials, catalytic substrates, topological insulators and superconducting radio frequency materials. *Phys. Chem. Chem. Phys.* **23**, Perspective, 7653–7672 (2021).
6. Tamtögl, A., Ruckhofer, A., Campi, D., Bremholm, M., Ernst, W. E., Hofmann, P. & Allison, W. Atom-surface van der Waals potentials of topological insulators and semimetals from scattering measurements. *Phys. Chem. Chem. Phys.* **23**, Perspective, 7637–7652 (2021).
7. Ruckhofer, A., Halbritter, S., Lund, H. E., Holt, A. J. U., Bianchi, M., Bremholm, M., Benedek, G., Hofmann, P., Ernst, W. E. & Tamtögl, A. Inelastic helium atom scattering from Sb₂Te₃(111): Surface phonon dispersion, kinematical focusing and surfing. *Phys. Chem. Chem. Phys.* **23**, 7806–7813 (2021).
8. Tamtögl, A. *Energy dissipation on Dirac and semimetal surfaces: Understanding surface dynamics on the nano-scale*. Habilitation (Graz University of Technology, Sept. 2020).
9. Tamtögl, A. Schnelle Bewegungen auf Oberflächen messen. *Nachrichten aus der Chemie* **68**, 65–67 (2020).
10. Ruckhofer, A., Campi, D., Bremholm, M., Hofmann, P., Benedek, G., Bernasconi, M., Ernst, W. E. & Tamtögl, A. Terahertz surface modes and electron-phonon coupling on Bi₂Se₃(111). *Phys. Rev. Research* **2**, 023186 (2020).
11. Benedek, G., Miret-Artés, S., Manson, J. R., Ruckhofer, A., Ernst, W. E. & Tamtögl, A. Origin of the Electron-Phonon Interaction of Topological Semimetal Surfaces Measured with Helium Atom Scattering. *J. Phys. Chem. Lett.* **11**, 1927–1933 (2020).
12. Tamtögl, A., Sacchi, M., Avidor, N., Calvo-Almazán, I., Townsend, P. S. M., Bremholm, M., Hofmann, P., Ellis, J. & Allison, W. Nanoscopic diffusion of water on a topological insulator. *Nat. Commun.* **11**, 278 (2020).
13. Tamtögl, A., Kraus, P., Mayrhofer-Reinhartshuber, M., Benedek, G., Bernasconi, M., Dragoni, D., Campi, D. & Ernst, W. E. Statics and dynamics of multivalley charge density waves in Sb(111). *npj Quantum Mater.* **4**, 28 (2019).
14. Ruckhofer, A., Tamtögl, A., Pusterhofer, M., Bremholm, M. & Ernst, W. E. Helium-Surface Interaction and Electronic Corrugation of Bi₂Se₃(111). *J. Phys. Chem. C* **123**, 17829–17841 (2019).
15. Tamtögl, A., Campi, D., Bremholm, M., Hedegaard, E. M. J., Iversen, B. B., Bianchi, M., Hofmann, P., Marzari, N., Benedek, G., Ellis, J. & Allison, W. Nanoscale surface dynamics of Bi₂Te₃(111): observation of a prominent surface acoustic wave and the role of van der Waals interactions. *Nanoscale* **10**, 14627–14636 (2018).
16. Tamtögl, A., Sacchi, M., Calvo-Almazán, I., Zbiri, M., Koza, M. M., Ernst, W. E. & Fouquet, P. Ultrafast molecular transport on carbon surfaces: The diffusion of ammonia on graphite. *Carbon* **126**, 23–30 (2018).
17. Tamtögl, A., Kraus, P., Avidor, N., Bremholm, M., Hedegaard, E. M. J., Iversen, B. B., Bianchi, M., Hofmann, P., Ellis, J., Allison, W., Benedek, G. & Ernst, W. E. Electron-Phonon Coupling and Surface Debye Temperature of Bi₂Te₃(111) from Helium Atom Scattering. *Phys. Rev. B* **95**, 195401 (2017).
18. Bahn, E., Tamtögl, A., Ellis, J., Allison, W. & Fouquet, P. Structure and dynamics investigations of a partially hydrogenated graphene/Ni(111) surface. *Carbon* **114**, 504–510 (2017).
19. Calvo-Almazán, I., Sacchi, M., Tamtögl, A., Bahn, E., Koza, M. M., Miret-Artés, S. & Fouquet, P. Ballistic diffusion in poly-aromatic hydrocarbons on graphite. *J. Phys. Chem. Lett.* **7**, 5285–5290 (2016).
20. Jones, A., Tamtögl, A., Calvo-Almazán, I. & Hansen, A. Continuous Compressed Sensing for Surface Dynamical Processes with Helium Atom Scattering. *Sci. Rep.* **6**, 27776 (2016).

A.1.2. Invited talks and seminars

- Atom scattering as a means to study energy dissipation on Dirac materials and open questions in 2D materials growth, Invited talk at the 5th International Workshop on Scattering of Atoms and Molecules from Surfaces (SAMS5), University of Cambridge, United Kingdom (2022).
- Energy dissipation on Dirac and 2D material interfaces: An approach to surface chemistry with neutral matter, Overview talk at the Lorentz workshop on [Energy Dissipation at Interfaces](#), Leiden University, Netherlands (2022).

- Structure and nanoscale dynamics of hydrogen containing molecules at carbon materials & interfaces, Keynote speaker at *Nanotec20*, University of Surrey, United Kingdom (2020).
- Surface diffusion of organic molecules based on reciprocal space techniques, *Johannes Kepler University Linz*, Austria (2019).
- Studying charge density wave systems and THz collective excitations with a meV atomic beam, *Cavendish Laboratory*, Cambridge, United Kingdom (2019).
- Surface Diffusion and Dynamics on Dirac Materials, *University of Graz*, Austria (2019).
- Insights in surface diffusion using neutron scattering: From ballistic motion to electronic friction, *Neutron and Muon Science User Meeting*, Warwick, United Kingdom (2019).
- Surface Diffusion and Dynamics on Dirac Materials, *Donostia International Physics Center*, Spain (2017).
- Surface Diffusion and Dynamics on Dirac Materials, *University of Wrocław*, Poland (2017).

A.1.3. Conference contributions (selected, as presenting author)

1. Tamtögl, A., Ruckhofer, A., Avidor, N., Sacchi, M. & Benedek, G. *From energy dissipation on Dirac materials to open questions in 2D materials growth in Interdisciplinary Surface Science Conference*. London, GBR, Apr. 19, 2021 (2021), 3
2. Tamtögl, A., Sabik, A., Hedgeland, H., Ward, D. J., Ruckhofer, A., Allison, W., Ellis, J., Antczak, G. & Fouquet, P. *The Range of Dynamics Studied with Atom-Surface Scattering: Verifying Rate Theory Across 14 Orders of Magnitude in International Conference on Scattering of Atoms and Molecules from Surfaces*. Madrid, ESP, Sept. 24–27, 2019 (2019)
3. Tamtögl, A., Sabik, A., Hedgeland, H., Ward, D. J., Ruckhofer, A., Allison, W., Antczak, G. & Ellis, J. *The Range of Dynamics Studied with Atom-Surface Scattering: Verifying Rate Theory Across 14 Orders of Magnitude in GRC Dynamics at Surfaces*. Newport, USA, July 27–Aug. 2, 2019 (2019)
4. Tamtögl, A., Kraus, P., Mayrhofer-Reinhartshuber, M., Ruckhofer, A., Benedek, G., Bernasconi, M., Dragoni, D., Campi, D., Bianchi, M., Hofmann, P. & Ernst, W. E. *Surface phonons and charge density wave excitations at topological semimetal and insulator surfaces in European Conference on Surface Science*. Aarhus, DNK, Aug. 26, 2018 (2018)
5. Tamtögl, A., Avidor, N., Calvo-Almazán, I., Townsend, P. S. M., Ward, D. J., Bianchi, M., Hofmann, P., Ellis, J., Allison, W. & Ernst, W. E. *Nanoscale Mass Transport on Dirac Materials in European Workshop on Epitaxial Graphene and 2D Materials*. Salamanca, ESP, May 21, 2018 (2018)
6. Tamtögl, A., Avidor, N., Calvo-Almazán, I., Townsend, P. S. M., Ward, D. J., Bianchi, M., Hofmann, P., Ellis, J., Allison, W. & Ernst, W. E. *Atomic-scale diffusion and friction on a topological insulator surface: H₂O on Bi₂Te₃(111) in GRC Dynamics at Surfaces*. Newport, USA, July 29–Aug. 4, 2017 (2017)
7. Tamtögl, A., Avidor, N., Calvo-Almazán, I., Townsend, P. S. M., Ward, D. J., Bianchi, M., Hofmann, P., Ellis, J., Allison, W., Sacchi, M. & Ernst, W. E. *Atomic-scale diffusion and friction on a topological insulator surface: H₂O on Bi₂Te₃(111) in Interdisciplinary Surface Science Conference*. Manchester, GBR, Apr. 10, 2017 (2017), 33
8. Tamtögl, A., Kraus, P., Avidor, N., Calvo-Almazán, I., Townsend, P., Ward, D. J., Bianchi, M., Hofmann, P., Ellis, J. & Allison, W. *Surface dynamics and atom-surface interaction of topological insulators from helium atom scattering in International Conference on Scattering of Atoms and Molecules from Surfaces*. Bergen, NOR, Aug. 23–26, 2016 (2016)
9. Tamtögl, A., Avidor, N., Calvo-Almazán, I., Townsend, P. S. M., Ward, D. J., Bianchi, M., Hofmann, P., Ellis, J. & Allison, W. *Diffusion on a topological insulator surface: H₂O on Bi₂Te₃(111) in Workshop on Dynamical Phenomena at Surfaces*. Milan, ITA, Sept. 19–21, 2016 (2016)
10. Tamtögl, A., Bahn, E., Zhu, J., Ward, D. J., Sacchi, M., Jenkins, S. J., Fouquet, P., Ellis, J. & Allison, W. *The motion of water on a hydrophobic surface in International Conference on Vibrations at Surfaces*. San Sebastian, ESP, June 22–26, 2015 (2015)

A.2. Teaching directory

Lectures and laboratory demonstration

Course title	LV-NO	Type	SWS	Year
Surface Dynamics at the Nanoscale	PHT.025UF	VO	2	2020
Surface Dynamics at the Nanoscale	PHT.025UF	VO	2	2019
Surface Dynamics at the Nanoscale	PHT.025UF	VO	2	2018
Molecules of Interest	PHT.022UF	VO	2	2017
Introduction to Surface Physics	University of Cambridge			2015
Experimental Physics 2 (electricity, optics)	511.062	UE	2	2013
Physics for Geomatic Engineering	511.061	UE	2	2012
Advanced Laboratory Exercises	511.121	LU	5	2012
Basic Laboratory Course (electricity and optics)	511.804	LU	6	2012
Advanced Laboratory 1	511.121	LU	5	2012
Basic Laboratory Course (mechanics and thermodynamics)	511.803	LU	3	2012
Advanced Laboratory Exercises	511.121	LU	5	2011
Basic Laboratory Course (electricity and optics)	511.804	LU	6	2011
Advanced Laboratory 1	511.121	LU	5	2011
Basic Laboratory Course (mechanics and thermodynamics)	511.803	LU	3	2011
Advanced Laboratory Exercises	511.121	LU	5	2010
Basic Laboratory Course (electricity and optics)	511.804	LU	6	2010
Advanced Laboratory 1	511.121	LU	5	2010
Physics	511.202	UE	1	2009
Advanced Laboratory Exercises	511.121	LU	5	2009
Basic Laboratory Course (electricity and optics)	511.804	LU	4	2009
Advanced Laboratory 1	511.121	LU	5	2009
Advanced Laboratory Exercises	511.121	LU	5	2008

Supervision of Bachelor, Master and PhD theses

Title	Name	Type	
Surface Dynamics and Atom-Surface Interaction of Topological ...	Adrian Ruckhofer	PhD	ongoing
Structure and Form Factor of Adsorbed Organic Molecules.	Victoria Schwab	BA	ongoing
Studying Stepped Semimetals and Dirac Materials with ...	Stephan J. Schmutzler	MA	2021
Surface Dynamics and Phonon Dispersion of $\text{Sb}_2\text{Te}_3(111)$ from ...	Simon Halbritter	MA	2020
Bestimmung der Gitterkonstanten von Kristallen & Molekülfilm ...	Maximilian Grillitsch	BA	2020
Molecular Dynamics Simulations: Modelling Surface Diffusion ...	Stephan J. Schmutzler	BA	2018
Setup and Characterisation of an Atomic Hydrogen source.	Andreas Grantner	BA	2018
Atom-surface Interaction of Topological Insulators Determined ...	Michael Pusterhofer	MA	2017
Surface Dynamics of the Topological Insulator Bi_2Se_3 from ...	Adrian Ruckhofer	MA	2017
A New Method of Polarisation Measurement for Spin-Echo ...	Benjamin Davey	MA*	2014

*part III project at the University of Cambridge (equivalent to a master's project)

Supervision on a day-to-day basis

Title	Name	Type	
Diffusion of Light Adsorbates on Transition Metal Surfaces.	Peter S. M. Townsend	PhD	2018
Thin Layers of Phthalocyanines on the (100) Surface of Silver.	Agata Sabik	PhD	2018
Molecular Diffusion on Surfaces of Carbon Materials.	Emanuel Bahn	PhD	2015
Classical and Quantum-Mechanical Atom-Surface ...	Patrick Kraus	PhD	2014
Surface Structure and Dynamics of $\text{Bi}(111)$ and ...	M. Mayrhofer-Reinhartshuber	PhD	2013