

Dr. Claudia Backes -CV

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Date of Birth: 04.04.1982
Place of Birth: Nuremberg, Germany
Nationality: German



BRIEF SUMMARY

I have received my Ph.D with honors in 2011 from the University of Erlangen, Germany. From 2011-2012, I supported the Erlangen Cluster of Excellence “Engineering of Advanced Materials” as deputy executive director and scientific coordinator. After receiving a fellowship grant from the German Research Foundation (DFG) in 2012, I moved to Jonathan Coleman’s groups at Trinity College Dublin, Ireland. In 2015, I returned to Germany and joined Heidelberg University at the Chair of Applied Physical Chemistry.

In 2016, I was awarded with the prestigious Emmy Noether funding from the German Research Foundation to establish my own research group at the Heidelberg University. Currently, my team comprises five PhD students, one postdoc and several undergraduate students. I have co-authored ~75 peer-reviewed papers in international journals including *Science*, *Nat. Chem.*, *Nat. Mater.*, *Nat. Commun.*, *Angew. Chemie*, *JACS*, *Adv. Mater.*, *ACS Nano* which have been cited >6,200 times (1,590 in 2018). I presented ~40 invited talks at international conferences over the past 5 years. Since 2011, my research has been devoted to liquid phase exfoliation of layered crystals, optical characterisation, deposition and functionalisation of nanosheets.

EDUCATION AND EMPLOYMENT

Since 10/2015 *Junior Research Group Leader* (DFG Emmy Noether from 04/2016)
Ruprecht-Karls University Heidelberg, Germany
Applied Physical Chemistry

Projects: Unifying principles in exfoliation, spectroscopic and microscopic characterisation of (novel) exfoliated layered materials with controlled nanosheet size and thickness, covalent and noncovalent functionalisation of layered inorganic materials, dielectric screening of excitons, interface and defect control, hybrid structures, deposition and thin film formation

11/2012-09/2015 *Postdoctoral Research Fellow* (DFG fellowship 2012-2014)
Trinity College Dublin, Ireland
School of Physics and CRANN, Chemical Physics of Nanostructures Group
Mentor: Prof. Jonathan N. Coleman, Professor of Chemical Physics

Projects: Exfoliation of layered crystals, size selection, spectroscopic/microscopic characterisation of nanosheets, MoS₂ functionalisation

- 05/2011-10/2012** *Scientific Coordinator and Deputy Executive Director*
Friedrich-Alexander University Erlangen-Nuremberg, Germany
Cluster of Excellence Engineering of Advanced Materials
- Responsibilities: Coordination of the renewal proposal within the German Excellence Initiative, coordination of a proposal for a new research building (Wissenschaftstrat), scientific coordination between research groups involved, budgeting and budget management, organisation of symposia
- 11/2007-04/2011** *Doctoral Research (Dr. rer. nat., summa cum laude)*
Friedrich-Alexander University Erlangen-Nuremberg, Germany
Institute of Advanced Materials and Processes (ZMP)
- Supervisor: Prof. Andreas Hirsch, Chair of Organic Chemistry II
Thesis Title: "Fundamental Aspects of Noncovalent Functionalisation of Single-Walled Carbon Nanotubes in Water"
- 08/2007** *Master of Science (average grade 1.5, Master Thesis 1.0)*
Friedrich-Alexander University Erlangen-Nuremberg, Germany
Degree Programme: Molecular Science, focus nanoscience
- 07/2005** *Bachelor of Science (average grade 1.9, Bachelor Thesis 1.0)*
Friedrich-Alexander University Erlangen-Nuremberg, Germany
Degree Programme: Molecular Science, focus nanoscience
- 05/2002** *Abitur (average grade 1.3)*
Dietrich Bonhoeffer Gymnasium, Oberasbach, Germany

RESEARCH INTERESTS/EXPERTISE

- Liquid exfoliation and dispersion of low-dimensional nanostructures
- Centrifugation-based size selection of nanomaterials
- Functionalisation of carbon allotropes
- Functionalisation of transition metal dichalcogenides and related inorganic 2D materials by various covalent and noncovalent strategies
- Dielectric screening of excitons
- Defect and interface control
- Hybrid structures from various nanomaterial building blocks (nano-nano composites)
- Controlled deposition of nanomaterials
- Characterisation techniques:
 Extinction/absorbance spectroscopy, fluorescence, Raman, FTIR spectroscopies, thermogravimetric analysis, atomic force microscopy, transmission and scanning electron microscopy, X-ray photoelectron spectroscopy, zeta potential and dynamic light scattering, analytical ultracentrifugation

SCHOLARSHIPS AND AWARDS

- 11/2019 (announced soon): Web of Science highly cited scientist (cross-field)
- 11/2019: ETH Zürich “Materials Research Prize for Young Investigators”
- 10/2018: Lautenschläger Award for excellent junior researchers in Heidelberg (25,000 €)
- 07/2017: Hengstberger Award to organise international symposium in Heidelberg (12,000 €)
- 04/2016: Emmy Noether Award from the Deutsche Forschungsgemeinschaft (~ 1.3 Mio €)
- 11/2012-11/2014: Postdoctoral fellowship from the Deutsche Forschungsgemeinschaft
- 2012: Springer Theses Award recognising outstanding PhD Theses

THIRD PARTY FUNDING

Period	Project Title	Funding Organization/ Project Number	Total (personnel + equipment + consumables)
2012-2014	Postdoctoral Fellowship “Dispersion and sorting of nanomaterials”	DFG (German Research Foundation)	~ € 120,000
2016 – 2019 (-2021)	Emmy Noether Programme “Towards supramolecular chemistry with inorganic 2D nanomaterial building blocks”	DFG (German Research Foundation)	€ 800.107 (+ € 448.500)
2017 – 2020	Collaborative Research Center SFB 1249 “N-hetero-polycycles as functional materials” – Project C02	DFG (German Research Foundation)	€ 155,600
2017-2021	“Strong Light-Matter Coupling in Nanoscale Semiconductors for Fast & Tunable Light-emitting Devices”	VW foundation	€ 172,200

SERVICE TO DISCIPLINE

- Reviewer activities for a range of journals including *Nature*, *Nature Chem.*, *Nature Commun.*, *Nature 2D Mat.*, *Angew. Chem.*, *J. Am. Chem. Soc.*, *ACS Nano.*, *Chem. Mater.*, *J. Mater. Chem.*, *Nanoscale* etc.
- Grant proposal reviewer activities for ERC (Starting and Consolidator Grant level), German Research Foundation DFG, DGE MSCA Fellowships, Humboldt postdoc scholarships
- Organisation of the international workshop “Carbon nanotubes meet 2D materials” in Heidelberg 11/2016 (~ 100 participants) and the symposium “The role of defects in low-dimensional nanostructures” 05/2018 (~ 70 participants)

- Coordination of the White Book on Synthetic Methods within the Graphene Flagship (> 100 authors, to be published in *2D Materials* in 2019)
- Member of the GDCh, ECS, MRS

TRAINING EXPERIENCE

- Currently supervision of 5 PhD students, 1 postdoc and several undergraduates. 9 bachelor theses and 3 master thesis completed since May 2016

Ongoing PhD Theses

Farnia Rashvand: *Chemical doping of liquid-exfoliated transition metal dichalcogenides*

Kevin Synnatschke: *Liquid phase exfoliation of novel layered crystals*

Steffen Ott: *Preparation of 2D material thin films for optical applications*

Maximilian Krings: *Supramolecular organization of N-Heteropolycycles on graphene*

Sebastian Grieger: *Defect functionalisation of liquid-exfoliated WS₂*

Completed Master Theses

Kevin Synnatschke: *Centrifugation-based size selection of liquid-exfoliated materials*

Sebastian Grieger: *Gold nanoparticle decoration of liquid-exfoliated WS₂*

Sabrina Steffens: *Flüssigphasenexfoliierung des Van-der-Waals-Kristalls Indiumselenid*

TEACHING EXPERIENCE

- SS2019: Physical Chemistry II (Thermodynamics, 4 SWS + tutorial, 4th semester bachelor)
- Setting up experiments in a new phys. chem. master labcourse at Heidelberg University
- Physical Chemistry II tutorial (Thermodynamics, SS2017, SS2018)
- Individual lectures embedded in the master class of Jana Zaumseil (Physical Chemistry, University of Heidelberg, WS2016, WS2017, WS2018, WS2019)
- Lab demonstrator in organic chemistry (during PhD)

FULL LIST OF PUBLICATIONS AND PRESENTATIONS

Articles in peer-reviewed journals (corresponding authorship indicated by *)

1. Lange, R.Z.; Synnatschke, K.; Qi, H.; Huber, N.; Hofer, G.; Liang, B.; Huck, C.; Pucci, A.; Kaiser, U.; Weber, T.; Backes, C.*; Schlüter, A.D.*
Enriching and quantifying porous single layer 2D polymers by exfoliation of chemically modified van der Waals crystals.
In review at *Angewandte Chemie* (2019).
2. Szydłowska, B.M.; Graf, A.; Kelly, A.; Blau, W.J.; Gather, M.C.; Zaumseil, J.; Backes, C.*
Preparation of WS₂-PMMA composite films for optical applications.
In review at *2D Materials* (2019).
3. Synnatschke, K.; Cieslik, P.; Harvey, A.; Costellanos-Gomez, A.; Tian, T.; Shih, C.; Chernikov, A.; Santos, E. J. G.*; Coleman, J. N.*; Backes, C.*
Length and thickness dependent optical response of liquid-exfoliated transition metal dichalcogenides.
In review at *Chemistry of Materials* (2019) with minor revisions.
4. Synnatschke, K.; Shao, S.; van Dinter, J.; Hofstetter, Y. J.; Kelly, D. J.; Grieger, S.; Haigh, S. J.; Vaynzof, Y.; Bensch, W.; Backes, C.*
Liquid exfoliation of Ni₂P₂S₆: Structural characterisation, size-dependent properties and degradation.
Chemistry of Materials (2019), just accepted, doi.org/10.1021/acs.chemmater.9b03468.
5. Ott, S.; Wolff, N.; Rashvand, F.; Rao, V. J.; Zaumseil, J.; Backes, C.*
Impact of the MoS₂ starting material on the dispersion quality and quantity after liquid phase exfoliation-
Chemistry of Materials (2019), 31, 20, 8424-8431.
6. Backes, C.; ...(>100 co-authors)...; Ferrari, A.C.; Garcia-Hernandez, M,
Production and processing of graphene and related materials
2D Materials (2019), accepted, Article reference: 2DM-103022.R2.
7. Backes, C.*; Campi, D.; Szydłowska, B.M.; Synnatschke, K.; Ojala, E.; Rashvand, F.; Harvey, A.; Griffin, A.; Sofer, Z.; Marzari, N.; Coleman, J.N.*; O'Regan, D.*
Equipartition of energy defines the size-thickness relationship in liquid-exfoliated nanosheets.
ACS Nano (2019), 13, 7050-7061.
8. Backes, C.*
Ten Years of Liquid-phase Exfoliation of Layered Crystals - A Bright Future ahead?
Chimia (2019), 73, 1-5 in special issue "Dimensionality in Chemistry.
9. Ogilvie, S. P.; Large, M.; O'Mara, M.; Lynch, P.; Lee, C. L.; King, A.; Backes, C.; Dalton, A.
Size selection of liquid-exfoliated 2D nanosheets.
2D Materials (2019), 6, 031002.
10. Li, Z.; Ottmann, A.; Sun, Q.; Kast, A.K.; Wang, K.; Zhang, T.; Meyer, H.-P.; Backes, C.; Kuebel, C.; Schröder, R. R.; Xiang, J.; Vaynzof, Y.; Klingeler, R.
Hierarchical MoS₂-carbon porous nanorods towards atomic interfacial engineering for high-performance lithium storage.
Journal of Materials Chemistry A (2019), 7, 7553-7564.
11. Vega-Mayoral, V.; Tian, R.; Kelly, A.; Griffin, A.; Harvey, A.; Borrelli, M.; Nisi, K.; Backes, C.; Coleman, J.N.

- Solvent-exfoliation stabilizes TiS₂ nanosheets against oxidation, facilitating lithium storage applications.
Nanoscale (2019), 11, 6206-6216.
12. Higgins, T. M.; Finn, S.; Matthiesen, M.; Grieger, S.; Synnatschke, K.; Brohmann, M.; Rother, M.; Backes, C.; Zaumseil, J.
Electrolyte-Gated n-Type Transistors Produced from Aqueous Inks of WS₂ Nanosheets.
Advanced Functional Materials (2018), 1804387.
 13. Djamil, J.; Hansen, A.-L.; Backes, C. Bensch, W.; Schürmann, U.; Kienle, L.; Düvel, A.; Heitjans, P.
Using light, X-rays and electrons for evaluation of the nanostructure of layered materials.
Nanoscale (2018), 10, 21142-21150.
 14. Harvey, A.; Backes, C.; Boland, J.B.; He, X.; Griffin, A.; Szydłowska, B.; Gabbett, C.; Donegan, J.F.; Coleman, J.N.
Non-resonant light scattering in dispersions of 2D nanosheets.
Nature Communications (2018), 9, 4553.
 15. Bertolazzi, S.; Gobbi, M.; Zhao, Y.; Backes, C.; Samorì, P.
Molecular chemistry approaches for tuning the properties of two-dimensional transition metal dichalcogenides.
Chemical Society Reviews (2018), 47, 6845-6888.
 16. Kłopotowski, L.; Czechowski, N.; Mitioglu, A.; Backes, C.; Maude, D.K.; Plochocka, P.
Long-lived photoluminescence polarization of localized excitons in liquid exfoliated monolayer enriched WS₂.
Nanotechnology (2018), 29, 335703.
 17. Dunklin, J.R.; Lafargue, P.; Higgins, T.M.; Forcherio, G.T.; Benamara, M.; McEvoy, N.; Roper, D.K.; Coleman, J.N.; Vaynzof, Y.; Backes, C.*
Monolayer-enriched production of Au-decorated WS₂ Nanosheets via Defect Engineering.
MRS Advances (2018) 3, 2435-2440.
 18. Castagnola, V.; Zhao, W.; Boselli, L.; Lo Giudice, M.C.; Meder, F.; Polo, E.; Paton, K.; Backes, C.; Coleman, J. N.; Dawson, K.
Biological recognition of graphene nanoflakes.
Nature Communications (2018), 9, 1577.
 19. Griffin, A.; Harvey, A.; Cunningham, B.; Scullion, D.; Tian, T.; Shih, C.-J.; Gruening, M.; Donegan, J. F.; Santos, E. J. G.; Backes, C.; Coleman, J. N.
Spectroscopic Size and Thickness Metrics for Liquid-Exfoliated h-BN.
Chemistry of Materials (2018), 30, 1998-2005.
 20. McAteer, D.; Godwin, I.J.; Ling, Z.; Harvey, A.; He, L.; Boland, C.S.; Vega-Mayoral, V.; Szydłowska, B.; Rovetta, A.A.; Backes, C.; Boland, J.B.; Chen, X.; Lyons, M.E.G.; Coleman, J.N.
Liquid Exfoliated Co(OH)₂ Nanosheets as Low-Cost, Yet High-Performance, Catalysts for the Oxygen Evolution Reaction
Advanced Energy Materials (2018), 8, 1702965
 21. Dunklin, J.R.; Lafargue, P.; Higgins, T.M.; Forcherio, G.T.; Benamara, M.; McEvoy, N.; Roper, D.K.; Coleman, J.N.; Vaynzof, Y.; Backes, C.*
Production of monolayer-rich gold-decorated 2H-WS₂ nanosheets by defect engineering.
NPJ 2D Materials and Applications (2018), 1, 43.
 22. Vega-Mayoral, V.; Borzda, T.; Vella, D.; Prijatelj, M.; Pogna, E.A.A.; Backes, C.; Coleman, J.N.; Cerullo, G.; Mihailovic, D.D.; Gadermaier, C.

- Charge carrier trapping and coalescence dynamics in few-layer MoS₂.
2D Materials (2018), 5, 015011.
23. Uebericke, L.; Coleman, J.N., Backes, C.*
Robustness of size selection and spectroscopic size, thickness and monolayer metrics of liquid-exfoliated WS₂.
Physica Status Solidi B (2017), 254, 170043.
 24. Duesberg, G.S.; Backes, C.
Druckbare Transistoren aus zweidimensionalen Nanoschichten: Elektronik.
Physik in unserer Zeit (2017) 48, 166-167.
 25. Forcherio, G.T.; Dunklin, J.R.; Backes, C.; Vaynzof, Y.; Benamara, M.; Roper D.K.
Gold nanoparticles physicochemically bonded onto tungsten disulfide nanosheet edges exhibit augmented plasmon damping.
AIP Advances (2017) 7, 075103.
 26. Kelly, A.G.; Hallam, T.; Backes, C.; Harvey, A.; Esmaily, A.S.; Godwin, I.; Coelho, J.; Nicolosi, V.; Lauth, J.; Kulkarni, A.; Kinge, S.; Siebbeles, L.D.A.; Duesberg, G.S.; Coleman, J.N.
All-printed thin-film transistors from networks of liquid-exfoliated nanosheets.
Science (2017) 356, 69-73.
 27. Backes, C.; Higgins, T.M.; Kelly, A.; Boland, C.; Harvey, A.; Hanlon, D.; Coleman J.N.
Guidelines for Exfoliation, Characterization and Processing of Layered Materials Produced by Liquid Exfoliation.
Chemistry of Materials (2017) 29, 243-255.
 28. Nerl, H.C.; Winther, K.; Hage, F.; Thygesen, K.; Houben, L.; Backes, C.; Coleman, J.N.; Ramasse, Q.; Nicolosi, V.
Probing the local nature of excitons and plasmons in few-layer MoS₂.
NPJ 2D Materials and Applications (2017) 1, 2.
 29. Laudénbach, J.; Schmid, D.; Herziger, F.; Hennrich, F.; Kappes, M.; Muoth, M.; Haluska, M.; Hof, F.; Backes, C.; Hauke, F.; Hirsch, A.; Maultzsch, J.
Diameter dependence of the defect-induced Raman modes in functionalized carbon nanotubes
Carbon (2017) 112, 1-7.
 30. Backes, C.*; Hanlon, D.; Szydłowska, B.M.; Harvey, A.; Smith, R.J.; Higgins, T.M.; Coleman, J.N.
Preparation of Liquid-exfoliated Transition Metal Dichalcogenide Nanosheets with Controlled Size and Thickness: A State of the Art Protocol.
Journal of Visualized Experiments (2016) 118, doi: 10.3791/54806.
 31. Boland, C.S.; Khan, U.; Ryan, G.; Barwich, S.; Charifou, R.; Harvey, A.; Backes, C.; Li, Z.; Ferreira, M.S.; Möbius, M.E.; Young, R.J.; Coleman, J.N.
Sensitive electromechanical sensors using viscoelastic graphene-polymer nanocomposites.
Science (2016) 354, 1257-1260.
 32. Kłopotowski, Ł.; Backes, C.; Mitioglu, A.A.; Vega-Mayoral, V.; Hanlon, D.; Coleman, J.N.; Ivanov, V.Y.; Maude, D.K.; Plochocka, P.
Revealing the nature of excitons in liquid exfoliated monolayer tungsten disulphide.
Nanotechnology (2016) 27, 425701.
 33. Graf, A.; Zakharko, Y.; Schießl, S. P.; Backes, C.; Pfohl, M.; Flavel, B. S.; Zaumseil, J.
Large scale, selective dispersion of long single-walled carbon nanotubes with high photoluminescence quantum yield by shear force mixing.
Carbon (2016) 105, 593.

34. Ferguson, A.; Caffrey, I.T.; Backes, C.; Coleman, J.N.; Bergin S.D.
Differentiating defect and basal plane contributions to the surface energy of graphite using inverse gas chromatography.
Chemistry of Materials (2016) 17, 6355-6366.
35. Bonaccorso, F.; Bartolotta, A.; Coleman, J. N.; Backes, C.
2D-Crystal-Based Functional Inks.
Advanced Materials (2016) 28, 6136-6166.
36. Chen, X.; Berner, N.C.; Backes, C.; Duesberg, G.S.; McDonald, A.R.
Functionalization of Two-Dimensional MoS₂: On the Reaction Between MoS₂ and Organic Thiols.
Angewandte Chemie Int. Ed. (2016) 55, 5803-5808.
37. Kurapati, R.; Backes, C.; Ménard-Moyon, C.; Coleman, J.N.; Bianco, A.
White Graphene undergoes Peroxidase Degradation.
Angewandte Chemie Int. Ed. (2016) 128, 5596-5601.
38. Gholamvand, Z.; McAteer, D.; Harvey, A.; Backes, C.; Coleman, J.N.
Electrochemical Applications of Two-Dimensional Nanosheets: The Effect of Nanosheet Length and Thickness.
Chemistry of Materials (2016) 28, 2641-2651.
39. Vega-Mayoral, V.; # Backes, C.; # Hanlon, D.; Khan, U.; Gholamvand, Z.; O'Brien, M.; Duesberg, G.S.; Gadermaier, C.; Coleman, J.N. (# authors contributed equally)
Photoluminescence from Liquid-Exfoliated WS₂ Monomers in Poly (Vinyl Alcohol) Polymer Composites.
Advanced Functional Materials (2016) 7, 1028-1039.
40. Backes, C.; Szydłowska, B.M.; Harvey, A.; Yuan, S.; Vega-Mayoral, V.; Davies, B.R.; Zhao, P.; Hanlon, D.; Santos, E.J.G.; Katsnelson, M.I.; Blau, W.J.; Gadermaier, C.; Coleman, J. N.
Production of Highly Monolayer Enriched Dispersions of Liquid-Exfoliated Nanosheets by Liquid Cascade Centrifugation.
ACS Nano (2016) 10, 1589-1601.
41. Harvey, A.; He, X.; Godwin, I.J.; Backes, C.; McAteer, D.; Berner, N.C.; McEvoy, N.; Ferguson, A.; Shmeliov, A.; Lyons, M. EG.; Nicolosi, V.; Duesberg, G.S.; Donegan, J.F.; Coleman, J.N.
Production of Ni(OH)₂ nanosheets by liquid phase exfoliation: from optical properties to electrochemical applications.
Journal of Materials Chemistry A (2016) 4, 11046-11059.
42. Seral-Ascaso, A.; Metel, S.; Pokle, A.; Backes, C.; Zhang, C.J.; Nerl, H.C.; Rode, K.; Berner, N.C.; Downing, C.; McEvoy, N.; Muñoz, E.; Harvey, A.; Gholamvand, Z.; Duesberg, G.S., Coleman, J.N.; Nicolosi, V.
Long-chain amine-templated synthesis of gallium sulfide and gallium selenide nanotubes.
Nanoscale (2016) 8, 11698-11706.
43. Gholamvand, Z.; McAteer, D.; Backes, C.; McEvoy, N.; Harvey, A.; Berner, N.C.; Hanlon, D.; Bradley, C.; Godwin, I.; Rovetta, A.; Lyons, M.E.G.; Duesberg, G.S.; Coleman, J.N.
Comparison of liquid exfoliated transition metal dichalcogenides reveals MoSe₂ to be the most effective hydrogen evolution catalyst.
Nanoscale (2016) 8, 5737-5749.
44. Backes, C.; Paton, K.R.; Hanlon, H.; Yuan, S.; Katsnelson, M.I.; Houston, J.; Smith, R.J.; McCloskey, D.; Donegan, J.F.; Coleman, J.N.
Spectroscopic metrics allow in situ measurement of mean size and thickness of liquid-exfoliated

few-layer graphene nanosheets.
Nanoscale (2016) 8, 4311-4323.

45. Hanlon, D.; # Backes, C.; # Doherty, E.; Cucinotta, C.S.; Berner, N.C.; Boland, C.; Lee, K.; Harvey, A.; Lynch, P.; Gholamvand, Z.; Zhang, S.; Wang, K.; Moynihan, G.; Pokle, A.; Ramasse, Q.M.; McEvoy, N.; Blau, W.J.; Wang, J.; Abellan, G.; Hauke, F.; Hirsch, A.; Sanvito, S.; O'Regan, D.; Duesberg, G.S.; Nicolosi, V. Coleman, J. N. (# authors contributed equally)
Liquid Exfoliation of Solvent-Stabilised Few-Layer Black Phosphorus for Applications Beyond Electronics.
Nature Communications (2015) 6, 8563.
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Basal-Plane Functionalization of Chemically-Exfoliated Molybdenum Disulfide by Diazonium Salts.
ACS Nano (2015), 9, 6018-6030.
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Preparation of gallium sulfide nanosheets by liquid exfoliation and their application as hydrogen evolution catalysts.
Chemistry of Materials (2015), 27, 3483-3493.
48. Backes, C.; Berner, N. C.; Chen, X.; Lafargue, P.; LaPlace, P.; Freeley, M.; Duesberg, G. S.; Coleman, J. N.; McDonald, A. R.,
Functionalization of liquid-exfoliated two-dimensional 2H-MoS₂.
Angewandte Chemie Int. Ed. (2015), 54, 2638-2642.
49. Varrla, E.; Backes, C.; Paton, K. R.; Harvey, A.; Gholamvand, Z.; McCauley, J.; Coleman, J. N.,
Large-Scale Production of Size-Controlled MoS₂ Nanosheets by Shear Exfoliation.
Chemistry of Materials (2015), 27, 1129-1139.
50. Berner, N. C.; Winters, S.; Backes, C.; Yim, C.; Dümbgen, K. C.; Kaminska, I.; Mackowski, S.; Cafolla, A. A.; Hirsch, A.; Duesberg, G. S.
Understanding and optimizing the packing density of perylene bisimide layers on CVD-grown graphene.
Nanoscale (2015) 7, 16337-16342.
51. Dirian K.; Backes, S.; Backes, C.; Strauss, V; Rodler, F.; Hirsch, A.; Guldi, D. M.;
Naphthalenebisimides as Photofunctional Surfactants for SWCNTs – Towards Water-Soluble Electron Donor-Acceptor Hybrids.
Chemical Science (2015), 6, 6886-6895.
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On-surface derivatisation of aromatic molecules on graphene: The importance of packing density.
Chemical Communications (2015), 51, 16778-16781.
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Sensitive, high-strain, high-rate, bodily motion sensors based on graphene-rubber composites.
ACS Nano (2014), 8 (9), 8819-8830.
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- Nicolosi, V., & Coleman, J. N.
Edge and Confinement Effects Allow in situ Measurement of Size and Thickness of Liquid-Exfoliated Nanosheets.
Nature Communications (2014), 5, 4576.
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Turbulence-assisted shear exfoliation of graphene using household detergent and a kitchen blender
Nanoscale (2014), 6, 11810-11819.
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Scalable production of large quantities of defect-free few-layer graphene by shear exfoliation in liquids.
Nature Materials, (2014), 13 (6), 624-630 (highlighted in media world-wide, for example Scientific American, New Scientist, BBC News, The Independent, Die Zeit).
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Production of Molybdenum Trioxide Nanosheets by Liquid Exfoliation and Their Application in High-Performance Supercapacitors.
Chemistry of Materials (2014), 26 (4), 1751-1763.
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Region-Selective Self-Assembly of Functionalized Carbon Allotropes from Solution.
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66. Backes, C., Schunk, T., Hauke, F. & Hirsch, A.
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67. Backes, C., Schmidt, C. D., Hauke, F. & Hirsch, A.
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Chemistry - An Asian Journal **6**, 438–444 (2011).
68. Backes, C., Englert, J. M., Bernhard, N., Hauke, F. & Hirsch, A.
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Dispersion of HiPco® and CoMoCAT® Single-Walled Nanotubes (SWNTs) by Water Soluble Pyrene Derivatives-Depletion of Small Diameter SWNTs.
Chemistry - A European Journal **16**, 3314–3317 (2010). (cover article)
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Advanced Materials **22**, 788–802 (2010).
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Fractioning HiPco and CoMoCAT SWCNTs via density gradient ultracentrifugation by the aid of a novel perylene bisimide derivative surfactant.
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High Population of Individualized SWCNTs through the Adsorption of Water-Soluble Perylenes.
Journal of the American Chemical Society **131**, 2172–2184 (2009).

Book chapter and book

Backes, C., “Noncovalent Functionalization of Carbon Nanotubes- Fundamental Aspects of Dispersion and Separation in Water” published within Springer Theses, Springer Berlin Heidelberg, **2012**. (Book)

Backes, C., Hirsch, A., “Noncovalent Functionalization of Carbon Nanotubes” in *Chemistry of Nanocarbons* (Eds.: T. Akasaka, F. Wudl, S. Nagase), John Wiley & Sons, **2010**, p. 528ff. (Book Chapter)

Contributions at international conferences and workshops

1. Backes, C., “*Chemical Degradation of Liquid-Exfoliated Nanosheets*”, Graphene Week, Helsinki, Finland **2019** (Invited Talk).
2. Backes, C., “*Liquid phase exfoliation of organic sheet stacks- A case study*”, Flatlands Beyond Graphene, Toulouse, France **2019** (Invited Talk).
3. Backes, C., “*What governs the “efficiency” of liquid phase exfoliation*”, NanoApp Workshop, Munich, Germany **2019** (Invited Talk).
4. Backes, C., “*What governs the “efficiency” of liquid phase exfoliation*”, Graphene, Rome, Italy **2019** (Invited Talk).
5. Backes, C., “*Liquid Exfoliation of Layered Crystals*”, E-MRS Spring Meeting, Nice, France **2019** (Invited Talk).
6. Backes, C., “*Towards Unifying Principles in Liquid Exfoliation of Various Layered Crystals*”, MRS Spring Meeting, Phoenix, USA **2019** (Invited Talk).
7. Backes, C., “*Towards unifying principles in exfoliation and spectroscopic characterisation of nanosheets produced from liquid phase exfoliation*”, Workshop “New light on mechanisms of chemical reactions”, Sao Paolo, Brazil **2018** (Invited Talk).
8. Backes, C., “*Liquid exfoliation and defect passivation of 2D materials*”, MRS Fall Meeting, Boston, USA **2018** (Invited Talk).
9. Backes, C., “*The versatility of liquid phase exfoliation of layered crystals*”, Workshop Sensing with graphene and 2-dimensional materials, Aachen, Germany **2018** (Invited Talk).
10. Backes, C., “*Towards unifying principles in liquid exfoliation of various layered crystals*”, NanoApp Workshop, München, Germany **2018** (Invited Talk).
11. Backes, C., “*Many candidates new in the zoo: Towards unifying principles in liquid exfoliation of various layered crystals*”, Flatlands Beyond Graphene, Leipzig, Germany **2018** (invited Talk)
12. Backes, C., “*Is there any material we cannot exfoliate in liquid? Exfoliation beyond inorganics - Back to C*”, NanoteC18, Brighton, UK **2018** (Invited Talk).

13. Backes, C., “*Liquid exfoliation as versatile technique to study fundamental properties of 2D materials*”, SPIE Optics and Photonics, San Diego, USA **2018** (Invited Talk).
14. Backes, C., “*How to make high quality dispersions*”, LPE10 Symposium, Dublin, Ireland **2018** (Invited Talk).
15. Backes, C., “*Liquid exfoliation and defect passivation of 2D materials*”, Graphene2018, Dresden, Germany **2018** (Invited Talk).
16. Backes, C., “*Exploring exciton physics in liquid-exfoliated 2D materials*”, ECS Meeting, Seattle, USA **2018** (Invited Talk).
17. Backes, C., “*Chemical functionalisation of transition metal dichalcogenides*”, International School on Frontier Research in 2D Materials, Cargese, Corsica, France **2018** (Invited Talk).
18. Backes, C., „*Liquid exfoliation as versatile tool to study fundamental properties of 2D materials*”, IWEPNM, Kirchberg, Austria **2018** (Invited Talk).
19. Backes, C., „*Exploring exciton physics in liquid-exfoliated 2D materials*”, DPG Spring Meeting, Berlin, Germany **2018** (Invited Talk).
20. Backes, C., “*Neue 2-dimensionale Materialien aus Exfolierung in Lösung*”, Thementage Grenz- und Oberflächentechnik, Zeulenroda, Germany **2018** (Invited Talk).
21. Backes, C., “*Liquid exfoliation as versatile technique to study the fundamental properties of 2D materials*”, International Workshop Frontiers in Chemistry of Molecular Materials, Madrid, Spain **2018** (Invited Talk).
22. Backes, C., “*Size-dependent optical properties of liquid-exfoliated 2D-materials*” and “*Exploring the chemical degradation and defect passivation of liquid-exfoliated nanosheets*”, Graphene Flagship Workshop, Fuerteventura, Spain **2018** (Invited Talks).
23. Backes, C., “*Liquid exfoliation and defect engineering in 2D materials*”, 4th Carbon Allotrope Symposium, Erlangen, Germany **2017** (Invited Talk).
24. Backes, C., “*Liquid exfoliation and defect engineering in 2D materials*”, Stuttgart Nanodays, Munich, Germany **2017** (Invited Talk).
25. Backes, C., “*Liquid exfoliation and defect engineering in 2D materials*”, Chem2DMat, Strasbourg, France **2017** (Invited Talk).
26. Backes, C., “*Liquid-exfoliated transition metal dichalcogenides: a story of excitons, spectroscopic metrics and functionalisation*”, ECS Meeting, New Orleans, USA **2017** (Invited Talk).
27. Backes, C., “*Liquid-exfoliated transition metal dichalcogenides: from spectroscopic metrics to functionalisation*”, TNT2017, Dresden **2017** (Keynote Lecture)
28. Backes, C., “*Functionalisation of MoS₂ and WS₂ in the liquid phase*”, IWEPNM, Kirchberg, Austria **2017**. (Poster Presentation).
29. Backes, C., “*Nanosheets in liquids: From spectroscopic metrics to functionalisation*”, Graphene Flagship Workshop, Tenerife, Spain **2017** (Invited Talk).
30. Backes, C., “*Liquid-exfoliated inorganic 2D-materials: From spectroscopic metrics to functionalisation*”, Workshop Carbon Nanotubes Meet 2D Materials, Heidelberg, Germany **2016** (Invited Talk).

31. Backes, C., “*Liquid-exfoliated transition metal dichalcogenides: A story of excitons, spectroscopic metrics and functionalisation*”, 2D Materials Workshop, MPI Halle, Germany **2016** (Invited Talk).
32. Backes, C.; Coleman, J.N., “*Liquid-exfoliated inorganic 2D-materials: Production, characterisation and functionalisation*”, CMD26, Groningen, Netherlands **2016** (Invited Talk).
33. Backes, C., “*Excitons in liquid-exfoliated transition metal dichalcogenides: ideal fingerprints for environmental effects*”, NanoteC, Dublin, Ireland **2016** (Contributed Talk)
34. Backes, C., “*How to make monolayer-rich liquid-exfoliated 2D materials suitable for fundamental studies*”, Flatlands beyond Graphene, Bled, Slovenia **2016** (Invited Talk).
35. Backes, C.; McDonald, A.; Hirsch, A.; Coleman, J.N., “*Wet chemical functionalisation of transition metal dichalcogenides*”, Graphene Week, Genova, Italy **2016** (Contributed Talk).
36. Backes, C., “*Liquid exfoliation of layered materials beyond graphene and transition metal dichalcogenides: GaS and black phosphorus*”, IWEPNM, Kirchberg, Austria **2016**. (Poster Presentation).
37. Backes, C.; Coleman, J.N., “*How to control length, thickness and ML content of liquid-exfoliated WS₂*”, Graphene Flagship Workshop, Fuerteventura, Spain **2016** (Invited Talk).
38. Backes, C., Hanlon, D.; Szydłowska B. M., Paton, K. Coleman, J. N., “*Liquid-exfoliated 2D materials suitable for studying fundamental optical properties*”, 3rd Carbon Allotrope Symposium, Erlangen, Germany **2015** (Poster Presentation).
39. Backes, C., Coleman, J. N., “*Spectroscopic Metrics for Determining Size and Thickness of Liquid Exfoliated Nanosheets in Dispersion*”, NanoteC, Oxford, U.K. **2015** (Contributed Talk).
40. Backes, C., Coleman, J. N., “*Spectroscopic metrics to determine monolayer content, mean number of layer and lateral dimensions of liquid exfoliated transition metal dichalcogenides*”, Graphene Week, Manchester, U.K. **2015** (Contributed Talk).
41. Backes, C., Coleman, J. N., “*Spectroscopic metrics for determining size and thickness of liquid exfoliated nanosheets in dispersion*”, ECS Meeting, Chicago, USA **2015** (Invited Talk).
42. Backes, C., Hanlon, D., Smith, R., Varrla, E., McEvoy, N., Berner, N. C., Duesberg, G. S., Coleman, J. N., “*Spectroscopic metrics for liquid-exfoliated 2D-materials: Number of layers, lateral size and monolayer content*”, IWEPNM, Kirchberg, Austria **2015**. (Poster Presentation).
43. Backes, C., Coleman, J. N., “*Spectroscopic metrics for determining size and thickness of liquid exfoliated nanosheets in dispersion*”, Materials Science, San Antonio, USA **2014** (Invited Talk).
44. Backes, C., Coleman, J. N., “*In situ spectroscopic metric to determine size and thickness of liquid-exfoliated graphene*”, NanoteC, Brussels, Belgium **2014** (Invited Talk).
45. Backes, C., Coleman, J. N., “*Spectroscopic metrics for determining size and thickness of liquid exfoliated nanosheets in dispersion*”, Flatlands Beyond Graphene, Dublin, Ireland **2014** (Contributed Talk).
46. Backes, C., Hirsch, A., Coleman, J. N., “*Chem on MoS₂*”, ChemonTubes, Riva del Garda, Italy **2014** (Contributed Talk).
47. Backes, C., Coleman, J. N., “*Using Edge and Confinement Effects for in situ Determination of Size and Thickness of Liquid-Exfoliated Nanosheets*”, IWEPNM, Kirchberg, Austria **2014** (Invited Talk).
48. Backes, C., Coleman, J. N., “*Liquid-exfoliation of layered inorganic materials-and a size and thickness metric.*” GRAPHEsp²⁰¹⁴, Lanzarote, Spain **2014** (Contributed Talk).

49. Backes, C., O'Neill, A., McEvoy, N., Duesberg, G., Zaumseil, J., Coleman, J. N., "Sorting and Analysis of Nanomaterials by Band Sedimentation Centrifugation." Synthetic Nanocarbon Materials Symposium, Dublin, Ireland **2013**. (Invited Talk and Poster Presentation).
50. Backes, C., Coleman, J.N., "Liquid-Exfoliation of Layered Materials." Graphene Flagship Kick-off Meeting Work Package Materials, Madrid, Spain **2013**. (Talk on behalf of J. N. Coleman).
51. Backes, C., Smith, R. J., McEvoy, N., O'Neill, A., Nicolosi, V., Duesberg, G., Coleman, J. N., "Sorting and Analysis of Liquid-Phase Exfoliated MoS₂ by Band Sedimentation Centrifugation." Flatlands Beyond Graphene, Bremen, Germany **2013**. (Contributed Talk).
52. Backes, C., Zaumseil, J., Hirsch, A., O'Neill, A., McEvoy, N., Duesberg, G., Coleman, J. N., "Sorting and Analysis of Nanomaterials by Band Sedimentation Centrifugation." IWEPM, Kirchberg, Austria **2013**. (Poster Presentation).
53. Backes, C., Hauke, F., Hirsch, A., "The Power of Ultracentrifugation – Sorting and Analysis of Carbon Nanotubes." Chem on Tubes, Arcachon, France **2012**. (Poster Presentation).
54. Backes, C., Hirsch, A., "Noncovalent Functionalization of Carbon Nanotubes by Designed Surfactants." IWEPM, Kirchberg, Austria **2012**. (Invited Talk).
55. Backes, C., Hirsch, A. "Functionalization of Synthetic Carbon Allotropes – The Chemist's Toolkit for Dispersion and Tailoring Surface Properties." Nanotough Dissemination Seminar, Lyngby, Denmark **2011**. (Invited Talk on behalf of A. Hirsch).
56. Backes, C., „Absorption Spectroscopy on Single-Walled Carbon Nanotubes – A Highly Versatile Characterization Tool.“ Colloquium Optical Spectroscopy, Berlin **2011**. (Invited Talk).
57. Backes, C., Hauke, F., Hirsch, A., "On the Way to Sorted Carbon Nanotubes Based on Tailor Made Surfactants." Euchems, Nuremberg **2010**. (Poster Presentation).
58. Backes, C., Schmidt, C. D., Hauke, F., Hirsch, A. "Solubilization and Density Gradient Fractioning of SWNTs by a Novel three Component Surfactant." IWEPM, Kirchberg, Austria **2009**. (Poster Presentation).

Invited talks at departmental seminars and national workshops

1. "Liquid exfoliation of layered crystals", Naples University, Italy, November **2019**.
2. "Many candidates new in the zoo: Towards unifying principles in liquid exfoliation of various layered crystals", Manchester University, U.K., October **2019**.
3. "Liquid exfoliation of layered crystals", Max Planck Institute for Polymer Science, Mainz, February **2019**.
4. "Many candidates new in the zoo: Towards unifying principles in liquid exfoliation of various layered crystals", Chalmers University, Gothenborg, January **2019**.
5. "Liquid exfoliation and defect engineering in 2D materials", Renishaw Inside Raman Seminar, Pliezhausen, October **2017**.
6. "Liquid exfoliation and defect engineering in 2D materials", Satellitentagung WiFO, Berlin, September **2017**.

7. *"The magic of chemistry on liquid-exfoliated 2D materials"*, Trinity College Dublin, Ireland, July **2017**.
8. *"Inorganic 2D materials in liquid dispersion: Exfoliation, characterisation and functionalisation"*, RWTH Aachen, April **2017**.
9. *"Liquid-exfoliated layered inorganic material: Production, characterisation and functionalisation"*, University of Mainz, Germany, November **2016**.
10. *"Liquid exfoliation and basic characterisation of transition metal dichalcogenides"*, Workshop WNMO, Niederstetten, Germany, October **2016**.
11. *"Powerful spectroscopic size and thickness metrics for liquid-exfoliated 2D materials-And now what??"*, Trinity College Dublin, Ireland, August **2016**.
12. *"Liquid-exfoliated layered materials materials: Production, size control and spectroscopic properties"*, MPI CPfS, Dresden, Germany, August **2016**.
13. *"Liquid-exfoliated 2D materials: Exfoliation, size control and optical properties"*, University of Heidelberg, Germany, June **2016**.
14. *"Liquid-exfoliated inorganic 2D-materials: Production, characterisation and functionalisation"*, InnovationLab, Heidelberg, Germany, Mai **2016**.
15. *"Liquid-exfoliated inorganic 2D-materials: Production, characterisation and functionalisation"*, University of Kiel, Germany, Mai **2016**.
16. *"Liquid-exfoliated inorganic 2D-materials: Production, characterisation and functionalisation"*, Queens University Belfast, UK, March **2016**.
17. *"Liquid-exfoliated inorganic 2D-materials: Production, characterisation and functionalisation"*, University of Würzburg, Germany, February **2016**.
18. *"How to change thickness-length relationships of liquid-exfoliated WS₂"*, Trinity College Dublin, Ireland, December **2015**
19. *"In situ spectroscopic metrics for liquid- exfoliated two-dimensional materials"*, University of Surrey, UK, June **2014**
20. *"In situ spectroscopic metrics for liquid- exfoliated two-dimensional materials"*, Trinity College Dublin, Ireland, June **2014**
21. *"In situ spectroscopic metrics for liquid- exfoliated two-dimensional materials"*, FU Berlin, Germany, June **2014**
22. *"Wet-chemical Functionalization of Nanomaterials"*, EAM Summer School, Luisenthal, Germany, July **2012**
23. *"Stabilization of Carbon Nanotubes in Solution by Noncovalent Functionalization"*, EAM Winter School, Kirchberg, Austria, March **2011**
24. *"The Route to Efficient Carbon Nanotube Sorting by the Aid of Designed Surfactants"*, ICMM Symposium, Bad Staffelstein, Germany, May **2010**
25. *"On the Way to the Separation of Single-walled Carbon Nanotubes by Noncovalent Functionalization"*, EAM Winter School, Kirchberg, Austria, March **2010**
26. *"Nanotube Surfactant Design – The Versatility of Water Soluble Perylene Bisimide Derivatives"*, ICMM Symposium, Bad Staffelstein, Germany, May **2009**

27. *"Aqueous Dispersion of SWCNTs by Amphiphilic Perylenes"*, ICMM Symposium, Muggendorf, Germany, May **2008**