

CURRICULUM VITAE

LARS ERIK WALLE

PERSONAL INFORMATION:

Name: Lars Erik Walle
Date of birth: April 24, 1979
Citizenship: Norwegian
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Degrees: PhD in physics, NTNU.
Master of Science in Physics (Sivilingeniør i Teknisk fysikk), NTNU.

Current position: Research Scientist, SINTEF Industri, Petroleum, Formation Physics

ADDRESSES:

Private:
Vestre Moholt-tun 2
NO-7050 Trondheim
Norway

Professional:
SINTEF Petroleum AS
S.P. Andersens vei 15 B
NO-7465 Trondheim
Norway

CURRENT RESEARCH INTERESTS AND EXPERTISE

- Experimental rock mechanics
- Chalk and sand stability and production
- Borehole stability
- Advanced shale testing methodology
- Development of novel experimental measurement techniques and laboratory methods for rock mechanics
- Material physics and surface science

EDUCATION:

2004 – 2009

PhD in Physics, Norwegian University of Science and Technology (NTNU), in the group of Prof. Anne Borg, with collaboration with Uppsala University. Thesis title: “Surface science studies of TiO₂ single crystal systems”

(ISBN 978-82-471-1887-0, <http://www.pvv.ntnu.no/~walle/phd/>).

Average grade: **A** (excellent)

1998 – 2004

Master of Science in Physics (Sivilingeniør i Teknisk fysikk), NTNU, June 2004.

Master thesis entitled: “Numerical identification of Kosterlitz-Thouless phase transition from 4th order charge correlations in a logarithmic plasma”. Thesis advisor: Prof. Asle Sudbø.

Average grade: **A** (excellent)

WORK EXPERIENCE:

- 2012 → Senior Research Scientist at SINTEF Formasjonsfysikk (Rock mechanics).
- 2010 – 2012 Postdoc in surface science at Department of Physics, NTNU, Trondheim.
- 2007 – 2012 On average 7-8 weeks of beamtime per year doing surface science photoemission experiments using synchrotron radiation at the Swedish national synchrotron facility, MAX-lab, in Lund, Sweden.
- 2004 – 2009 PhD student at Department of Physics, NTNU, Trondheim.
- 2006 Research stay in the group of professor Anders Sandell, Uppsala University, Sweden.
- 2003 Research assistant at the interfacial light scattering laboratory, Department of Physics, NTNU, Trondheim.
- 2001 Research assistant at SINTEF Electronics and Cybernetics, Trondheim.
- 2000 Research assistant at Statoil Research Centre, Trondheim.

TEACHING EXPERIENCE:

- 2018 Lecturing the physics part of TPG4100 "Physics and geophysics", Department of Petroleum Technology and Applied Geophysics, NTNU.
- 2017 Lecturing the physics part of TPG4100 "Physics and geophysics", Department of Petroleum Technology and Applied Geophysics, NTNU.
- 2016 Supervision of 2 students during their Master Thesis work: Niklas Ø. Brevik ("Experimental Study of Fracture Toughness in Sedimentary Rocks") and Stina S. Jensen ("Experimental Study of Direct Tensile Strength in Sedimentary Rocks").
- 2016 Lecturing the physics part of TPG4100 "Physics and geophysics", Department of Petroleum Technology and Applied Geophysics, NTNU.
- 2010 – 2011 Responsible for the physics project in Teknostart and Realstart for new physics and mathematics students (~160 students).
- 2010 – 2011 Lecturing the physics part (~30% of the whole course) of TPG4100 "Physics and geophysics" for around 100 students.
- 2008 Coordinator for TFY4106 and TFY4120 Physics laboratory courses (~500 students) at Department of Physics, NTNU.
- 2007 Lecturing TFY4300 "Energy and environmental physics" for 6 weeks at Department of Physics, NTNU.
- 2006 – 2009 Teaching assistant in the following physics laboratory courses at Department of Physics, NTNU: TFY4102, TFY4106, TFY4110, TFY4120, TFY4135 and TFY4180 Physics.
- 1998 – 2004 Student assistant in numerous courses in physics, mathematics, chemistry, programming and philosophy at NTNU.

COMMITTEES AND POSITIONS:

- 2016 → Hovedverneombud, SINTEF Petroleum AS.
- 2016 – 2017 Deputy member of the board at SINTEF Petroleum AS.
- 2015 → HMS-responsibility for the Formation Physics laboratory, SINTEF.
- 2015 → External member of the study program board for the bachelor and master programs in physics, Department of Physics, NTNU.
- 2010 – 2012 Member of the department board, Department of Physics, NTNU, Trondheim.
- 2010 Member of the working committee for the project "Forprosjekt for norsk deltakelse i MAX IV", funded by the Norwegian Research Council.
- 2010 Member of a hiring committee to judge the applicants for a PhD position in the surface science group, Department of Physics, NTNU.
- 2008 – 2009 Member of the faculty research committee, Faculty of Natural Sciences and Technology, NTNU, Trondheim.

SPECIAL COURSES:

SINTEF scientific communication (Visual experts in media) and project leader courses. SINTEF HMS courses on handling of chemicals, risk evaluation and work environment. NTNU courses on radioactive sources and X-ray radiation, laser safety, HMS-platform, crane and lifting operations. Nordic and European Summer School: "VUV and X-Ray Research for the Future Using FEL's and Ultra Brilliant Sources", MAX-lab, Lund, Sweden.

PROFESSIONAL MEMBERSHIPS:

Society of Petroleum Engineers (SPE), American Rock Mechanics Association (ARMA) and Norsk Petroleumsforening (NPF).

PUBLICATION LIST

Peer-reviewed papers:

L. E. Walle, A. M. Stroisz, N. Ø. Brevik, S. S. Jensen and R. M. Holt, " Laboratory Measurements of Strength Parameters for Fracturing", ARMA 17-724 (2017).

P. Cerasi and L. E. Walle, " Investigation of potential loss of injectivity and formation integrity due to pressure cycling", Energy Procedia 86, 420-421 (2016)

L. Li and L. E. Walle, "Modelling hole failure under anisotropic stresses using DEM", ARMA 16-683 (2016).

A. M. Stroisz, S. Pradhan, M. Jordan, P. Cerasi, L. E. Walle, A. Bauer, J. F. Stenebråten, S. Stanchits, R. Will, "Monitoring of fracture reopening in sandstones", ARMA 16-492 (2016).

P. Cerasi and L. E. Walle, "Investigation of potential loss of injectivity and formation integrity due to pressure cycling", Energy Procedia 86 (2016).

L. E. Walle and E. Papamichos, "Acidizing of hollow cylinder chalk specimens and its impact on rock strength and wormhole network structure", ARMA 15-566 (2015).

P. Cerasi, A. Berntsen, L. E. Walle and E. Papamichos, "Sand production delay in gas flow experiments", ARMA 15-246 (2015).

M. Leetmaa, B. Wang, D. Ragazzon, L. E. Walle, A. Borg, P. Uvdal, A. Sandell and N. V. Skorodumov, "Kinetics of water adsorption on TiO₂(110)", Physics, Chemistry and application of nanostructures (2015).

M. H. Farstad, D. Ragazzon, L. E. Walle, A. Schaefer, A. Sandell, A. Borg, "Water adsorption on TiO_x thin films grown on Au(111)", J. Phys. Chem. C 119, 6660 (2015).

D. Ragazzon, M. H. Farstad, A. Schaefer, L. E. Walle, P. Uvdal, A. Borg and A. Sandell, "Growth of TiO₂(B)(001) on Au(111) by Chemical Vapor Deposition", Surf. Sci. 633, 102 (2015).

P. Cerasi, A. M. Stroisz, L. E. Walle and A. Lavrov, "Laboratory testing of shale rock specimens to assess thermal fracturing risk in caprock surrounding injection wells", ARMA 14-7077 (2014).

L. E. Walle, D. Ragazzon, A. Borg, P. Uvdal and A. Sandell, "Photoemission studies of water dissociation on rutile TiO₂(110): Aspects on experimental procedures and the influence of steps", Appl. Surf. Sci. 303, 245 (2014).

- V. R. Fernandes, J. Gustafson, M. H. Farstad, L. E. Walle, S. Blomberg, E. Lundgren, H. J. Venvik and A. Borg, "H₂ reduction of surface oxides on Pd-based membrane model systems – The case of Pd(100) and Pd₇₅Ag₂₅(100)", *Appl. Surf. Sci.* 313, 794 (2014).
- L. E. Walle, D. Ragazzon, A. Borg, P. Uvdal and A. Sandell, "Competing water dissociation channels on rutile TiO₂(110)", *Surf. Sci.* 621, 77 (2014).
- V. R. Fernandes, J. Gustafson, I.-H. Svenum, M. H. Farstad, L. E. Walle, S. Blomberg, E. Lundgren and A. Borg, "Reduction behavior of oxidized Pd(100) and Pd₇₅Ag₂₅(100) surface using CO", *Surf. Sci.* 621, 31 (2014).
- A. Bauer, L. E. Walle, J. Stenebråten and E. Papamichos, "Impact of acidizing-induced wormholes in chalk on rock strength", *ARMA* 13-534 (2013).
- D. Ragazzon, A. Schaeffer, M. H. Farstad, L. E. Walle, P. Palmgren, A. Borg, P. Uvdal and A. Sandell, "Chemical vapour deposition of ordered TiO_x nanostructures on Au(111)", *Surf. Sci.* 617, 211 (2013).
- A. Borg, L. E. Walle, K. Schulte, J. Gustafson, C. F. Weststrate, E. Lundgren and J. N. Andersen, "Oxide Formation and CO-Induced Oxide Reduction on Pd₇₅Ag₂₅(100) Surface", *AIP Conference Proceedings* 1517, 217 (2013).
- A. Schaefer, D. Ragazzon, L. E. Walle, M. H. Farstad, A. Wichmann, M. Bäumer, A. Borg and A. Sandell, "Controlled modification of nanoporous gold: Chemical Vapor deposition of TiO₂ in ultrahigh vacuum", *Appl. Surf. Sci.* 282, 439 (2013).
- M. Amft, L. E. Walle, D. Ragazzon, A. Borg, P. Uvdal, N. Skorodumova and A. Sandell, "A molecular mechanism for the water-hydroxyl balance during wetting of TiO₂", *J. Phys. Chem. C* 117, 17078 (2013).
- A. Sandell, L. E. Walle, J. Blomquist, P. Uvdal and A. Borg, "Heterogeneous reaction between Li and anatase TiO₂ nanoparticles under ultra-high vacuum", *Phys. Chem. Chem. Phys.* 15, 12283 (2013).
- L. E. Walle, A. Borg, P. Uvdal and A. Sandell, "Probing the influence from residual Ti interstitials on water adsorption on TiO₂(110)", *Phys. Rev. B* 86, 205416 (2012).
- L. E. Walle, H. Grönbeck, V. R. Fernandes, S. Blomberg, M. H. Farstad, K. Schulte, J. Gustafson, J. N. Andersen, E. Lundgren and A. Borg, "Surface composition of clean and oxidized Pd₇₅Ag₂₅(100) from photoelectron spectroscopy and density functional theory calculations", *Surf. Sci.* 606, 1777 (2012).
- A. Schaefer, D. Ragazzon, A. Wittstock, L. E. Walle, A. Borg, M. Bäumer and A. Sandell, "Towards Controlled Modification of Nanoporous Gold. A Detailed Surface Science Study on Cleaning and Oxidation", *J. Phys. Chem C* 116, 4564 (2012).
- L. E. Walle, S. Agnoli, I.-H. Svenum, A. Borg, L. Artiglia, P. Krüger, A. Sandell and G. Granozzi, "High resolution photoemission and x-ray absorption spectroscopy of a lepidocrocite-like TiO₂ nanosheet on Pt(110) (1 × 2)", *J. Chem. Phys.* 135, 054706 (2011).
- L. E. Walle, A. Borg, E. M. J. Johansson, S. Plogmaker, H. Rensmo, P. Uvdal and A. Sandell, "Mixed dissociative and molecular water adsorption on anatase TiO₂(101)", *J. Phys. Chem. C* 115, 9545 (2011).

A. Sandell, B. Sanyal, L. E. Walle, P. Uvdal and A. Borg, "Probing the conduction band edge of transition metal oxides by x-ray absorption spectroscopy", *J. Electron. Spectrosc. Relat. Phenom.* 183, 107 (2011).

I.-H. Svenum, Ø. Borck, L. E. Walle, K. Schulte and A. Borg, "Adsorption of CO on Ni₃Al(111) investigated using high-resolution photoemission spectroscopy and density functional theory", *Phys. Rev. B* 81, 245432 (2010).

E. M. J. Johansson, S. Plogmaker, L. E. Walle, R. Schölin, A. Borg, A. Sandell and H. Rensmo, "Comparing surface binding of the maleic anhydride anchor group on single crystalline anatase TiO₂(101), (100) and (001) surfaces", *J. Phys. Chem. C* 114, 15015 (2010).

A. Schaefer, A. Sandell, L. E. Walle, V. Zielasek, M. Schowalte, A. Rosenauer and M. Bäumer, "Chemistry of thin film formation and stability during praseodymium oxide deposition on Si(111) under oxygen-deficient conditions", *Surf. Sci.* 604, 1287 (2010).

Ø. Borck, I.-H. Svenum, L. E. Walle, T. H. Andersen, K. Schulte and A. Borg, "Adsorption of methylamine on Ni₃Al(111) and NiAl(110) - a high resolution photoelectron spectroscopy and density functional theory study", *J. Phys. Condens. Matter* 22, 395004 (2010).

H. F. Hansen, L. E. Walle and A. Hansen, "Wealth and income distributions in Norway: A case study", *Dynamics of Socio-Economic Systems* 2, 110 (2010).

A. Ramachandran, Ø. Borck, T. H. Andersen, I.-H. Svenum, L. E. Walle and A. Borg, "Methanol adsorption on Pd(110) and Ag/Pd(110) studied by high resolution photoelectron spectroscopy", *Surf. Sci.* 604, 89 (2010).

L. E. Walle, A. Borg, P. Uvdal and A. Sandell, "Experimental evidence for mixed dissociative and molecular adsorption of water on the rutile TiO₂(110) surface", *Phys. Rev. B* 80, 235436 (2009).

I.-H. Svenum, Ø. Borck, K. Schulte, L. E. Walle and A. Borg, "Adsorption of methanol on NiAl(110) and Ni₃Al(111): A high resolution PES study", *Surf. Sci.* 603, 2370 (2009).

A. Schaefer, V. Zielasek, Th. Schmidt, A. Sandell, M. Schowalter, O. Seifarth, L. E. Walle, Ch. Schulz, J. Wollschläger, T. Schroeder, A. Rosenauer, J. Falta and M. Bäumer, "Growth of praseodymium oxide on Si(111) under oxygen deficient conditions", *Phys. Rev. B* 80, 045414 (2009).

A. Sandell, B. Sanyal, L. E. Walle, J. H. Richter, S. Plogmaker, P. G. Karlsson, A. Borg and P. Uvdal, "Probing and modifying the empty-state threshold of anatase TiO₂: Experiments and ab initio theory", *Phys. Rev. B* 78, 075113 (2008).

J. Blomquist, L. E. Walle, P. Uvdal, A. Borg and A. Sandell, "Water Dissociation on Single Crystalline Anatase TiO₂(001) studied by Photoelectron Spectroscopy", *J. Phys. Chem. C* 112, 16616 (2008).

Oral scientific presentations at conferences:

51st US Rock Mechanics/Geomechanics Symposium (ARMA), San Francisco, USA, June 2017.
"Laboratory Measurements of Strength Parameters for Fracturing".

50th US Rock Mechanics/Geomechanics Symposium (ARMA), Houston, USA, June 2016.
"Modelling hole failure under anisotropic stresses using DEM".

49th US Rock Mechanics/Geomechanics Symposium (ARMA), San Francisco, USA, June 2015. "Acidizing of hollow cylinder chalk specimens and its impact on rock strength and wormhole network structure".

SPE workshop on Sand production, Langkawi, Malaysia, November 2014. "Influence of sandstone saturation class on sand production".

47th US Rock Mechanics/Geomechanics Symposium (ARMA), San Francisco, USA, June 2013. "Impact of acidizing-induced wormholes in chalk on rock strength".

European Conference on Surface Science 28 (ECOSS), Wroclaw, Polen, August 28 – September 2, 2011. "Oxide formation and adsorption of CO on Pd₅₇Cu₄₃(100)".

10th International Conference on the Structure of Surfaces (ICSOS-10), Hong Kong, August 1 – 5, 2011. "Mixed dissociative and molecular water adsorption on anatase TiO₂(101)".

American Vacuum Society (AVS) 57th International Symposium & Exhibition, Albuquerque, USA, October 17 – 22, 2010. "Experimental Evidence for Mixed Dissociative and Molecular Adsorption of Water on a Rutile TiO₂(110) Surface without Oxygen Vacancies".

European Conference on Surface Science 27 (ECOSS), Groningen, Netherlands, August 29 – September 3, 2010. "Oxide formation and CO induced oxide reduction on the Pd₇₅Ag₂₅(100) surface".

American Vacuum Society (AVS) 55th International Symposium & Exhibition, Boston, USA, October 19 – 24, 2008. "Growth of Au on Single Crystalline Anatase TiO₂(101) and (001): Probing Under-Coordinated Sites with Core Level Photoelectron Spectroscopy", oral presentation.

Popular scientific presentations/publications:

Popular scientific publication in Gemini: "Avslører geologiens x-faktor", <https://gemini.no/2018/01/avslorer-geologiens-x-faktor/>, January 24th 2018.

(An English version is also available at both the Gemini and AlphaGalileo webpages: "Revealing the geology's X-factor", <https://geminiresearchnews.com/2018/01/revealing-geologys-x-factor>, <https://www.alphagalileo.org/ViewItem.aspx?ItemId=183081&CultureCode=en>).

Popular scientific publication in Teknisk Ukeblad about the True Triaxial test system: "Tok 8 år og 14 millioner kroner å lage - kan spare oljenæringen for hundrevis av millioner", <https://www.tu.no/artikler/tok-8-ar-og-14-milljoner-kroner-a-lage-skal-spare-oljenaeringen-for-milliarder/426307?key=Q2Rr38DW>, January 23rd 2018.

(A Swedish version of the publication above has also been published in NyTeknik: "Ny testrigg för oljeindustrin ska spara miljarder", <https://www.nyteknik.se/energi/ny-testrigg-for-oljeindustrin-ska-spara-miljoner-6895231>, January 29th 2018)

YouTube-video of the newly installed True Triaxial test system: <https://youtu.be/5xjha6SL6CU>, February 2018.

Popular scientific presentation at the kick-off instituttsamling for the whole of SINTEF Industri: "Forskning vi er stolt av: Formasjonsfysikklaboratiet", Clarion Hotel & Congress Trondheim, Brattøra, January 16th 2018.

Social media posting on Facebook together with MTS Corporation, Minneapolis, about the new True Triaxial apparatus, January 17th 2018.

Press release together with MTS Corporation, Minneapolis: "MTS & Nordic Research specialist SINTEF co-develop next generation geomaterials modeling technology vital to future oil exploration", http://www.mts.com/en/about/news/MTS_4036743, January 2018.

Seminar, together with MTS Sweden, presenting SINTEF Petroleum and ongoing research, for potential customers, partners and students in the Trondheim-area, May 2017.

Popular scientific presentation and guided tour of the Formation Physics laboratory for more than 50 participants during the bi-annual SINTEF conference, March 2017.

Numerous guided tours of the Formation Physics laboratory for customers, partners and management in 2016 and 2017.

Popular scientific presentation of the Formation Physics laboratory and the new True Triaxial apparatus for Konsernledelsen at SINTEF, Trondheim, February 2017.

Presentation of SINTEF Petroleum and scientific education and career opportunities for forskerklasse from videregående skole, Trondheim, February 2016.

Press release together with MTS Corporation, Minneapolis: "Premier Scandinavia research organization, SINTEF, selects MTS Test Systems for oil and gas research", http://www.mts.com/en/about/news/MTS_2010511, June 2014.

Presentation of Formasjonsfysikk at Instituttdagen, 2013.

Introduction to LaTeX for "Jenter og data" at NTNU, April 2012.

Presentation of the Surface Science research team during "Researcher's Night" at NTNU 2010 and 2011.

Responsible for the introductory program "Jentedagen" to encourage girls to study science at Department of Physics, NTNU, 2008 and 2009.

Responsible for the official webpage and the scientific presentation to the public during "Fysikkåret 2005" for Norsk Fysisk Selskap.