

Alexey Mavrinskiy, Ph.D.

Solid State Physicist — Carbon nanostructures · Organic electronics · Structural characterization

Ottawa, Ontario, Canada · mavrinsky@gmail.com · ~30 publications, 13 in international peer-reviewed journals

PROFILE

Experimental solid state physicist and materials scientist. My work has followed one chain from both ends: how a molecule is built, how it packs, and what that packing does to charge transport in a real device. That took me from thermoelectric transport in carbon nanotubes, through electron spin resonance of carbon nanostructures grown on halogenated polymer surfaces, to the supramolecular self-assembly of discotic liquid-crystalline polycyclic aromatic hydrocarbons in the groups of Klaus Müllen and Wojciech Pisula at the Max Planck Institute for Polymer Research.

Comfortable at the instrument and at the whiteboard: I have built the rigs (a vacuum cryogenic setup for thermoelectric measurement, a zone-casting apparatus for oriented films, a shearing setup for solid-state alignment), run the characterization, and written the code that reduced the data.

EXPERIMENTAL & ANALYTICAL SKILLS

X-ray	2D WAXS, 2D SAXS (including synchrotron measurements), X-ray reflectivity, XPS
Microscopy	Atomic force microscopy (AFM), transmission electron microscopy (TEM), polarized optical microscopy (POM)
Spectroscopy	ESR / EPR (including cryogenic temperatures), Auger, FT-IR, Raman, UV-Vis, MALDI mass spectrometry
Thermal	DSC, TGA
Devices	Organic field-effect transistor and photovoltaic fabrication and measurement; space-charge-limited current method for charge-carrier mobility in liquid-crystalline materials
Sample prep	Thin-film deposition from solution (drop-, dip-, spin- and zone-casting), shearing, extrusion, thermal sublimation, pulsed laser deposition; chemical dehydrohalogenation of polymer films
Computation	Maple, MathCAD, MATLAB, Spartan, HyperChem; computer control of experiments; application development in Delphi, C#, Python, VBA

RESEARCH EXPERIENCE

Max Planck Institute for Polymer Research — Mainz, Germany

2008 – 2010

Research Scientist / Physicist — groups of Prof. Klaus Müllen and Dr. Wojciech Pisula

Control of the supramolecular self-organization of discotic liquid-crystalline polycyclic aromatic hydrocarbons, with a view to their use in electronic devices

- Investigated the relationship between molecular architecture, long-range order and the microscopic properties of organic semiconductor samples, primarily by 2D WAXS/SAXS supported by AFM, POM, DSC and TGA.
- Assessed the viability of self-assembled organic systems in field-effect transistors and photovoltaic cells; adapted the space-charge-limited current method to measure charge-carrier mobility in liquid-crystalline materials.
- Designed, built and commissioned experimental equipment for producing oriented thin films — a zone-casting rig for solution processing and a shearing setup for the solid state.
- Maintained and repaired the X-ray instrumentation, replaced components, handled installation and computer interfacing, and mounted a vacuum chamber for the 2D WAXS instrument.
- Participated in the installation and commissioning of a portable ultra-high-vacuum suitcase for transferring samples from a sector-field tandem mass spectrometer to a UHV STM.
- Instructed visiting researchers and students on the X-ray techniques, AFM, POM, DSC, TGA, vacuum sublimation and plasma cleaning instruments; reported results on a regular basis.

Max Planck Institute for Polymer Research — Mainz, Germany

2006 – 2007

Research Scientist — with Priv.-Doz. Dr. Martin Baumgarten

Optical absorption of carbon nanosystems with hydrogen; ESR absorption of chemically dehydrohalogenated poly(vinylidene fluoride)

- Designed and ran ESR experiments at cryogenic temperatures, measuring the temperature dependence of the absorption.
- Performed chemical dehydrohalogenation of halogen-containing polymer films to grow carbon-rich nanostructures, and carried out the surface analysis of the resulting samples.

R&D Centre “Low-Dimensional Carbon”, Chelyabinsk State Pedagogical University — Russia

2003 – 2006, 2007 – 2008

Research Scientist

Carbon-containing nanofilms formed on halogen-containing polymer surfaces upon chemical functionalization

- Analysed, calculated and modelled the properties and behaviour of low-dimensional carbon structures; synthesized and characterized chain carbon nanostructures.
- Carried out quantitative analysis of large Auger, XPS, IR, UV-Vis and ESR data sets, and wrote the software that performed the analysis — the volume of data made manual reduction impractical.
- Reported results on a regular basis and instructed students on the operation of the instruments.

Department of General and Theoretical Physics, Chelyabinsk State Pedagogical University — Russia

2000 – 2003

Research Assistant / Ph.D. candidate

Electrical, thermal and thermoelectric properties of low-dimensional carbon materials

- Developed a π -electron model describing the temperature dependence of the thermoelectric power in semimetallic carbon nanotubes.
- Designed and built the experimental apparatus to test it: measurement of the temperature dependence of thermoelectric power under vacuum and at cryogenic temperatures, together with the application that visualized the data.
- Analysed Auger data of carbon nanotubes; studied electron relaxation time in irradiated pyrolytic carbon.

SOFTWARE & DATA ENGINEERING

Alongside the research, and ever since, I have worked as a professional software developer — more than twenty years of it, currently on a four-tier forensic laboratory platform in C# and SQL Server. In practice that means the instrument-side and data-side work on this résumé is not something I outsourced: the data reduction code, the visualization, the acquisition control and the database schemas were mine.

For a laboratory this tends to be the useful half of the profile. Experimental physics generates more data than anyone reduces by hand, and someone who can write the pipeline, tune the database under it and still argue about what the measurement means is rarer than either specialist alone. *A separate résumé covering the software work in full is available on request.*

EDUCATION

2006 **Ph.D. in Physics and Mathematics** — Chelyabinsk State Pedagogical University, Russia. Dissertation: *Thermoelectric Power in Carbon Nanotubes*.

2000 **M.Sc. in Physics** — Magnitogorsk State University, Russia.

SELECTED PUBLICATIONS

Articles in international peer-reviewed journals. Roughly thirty publications in total, including conference proceedings and Russian-language journals; the full list is available on request.

1. P. K. Madathil, J.-G. Lim, T.-D. Kim, D. Beckmann, **A. Mavrinskiy**, W. Pisula, M. Baumgarten, K. Müllen, K.-S. Lee. Synthesis and characterization of novel anthracene derivatives for organic field-effect transistors. *Chemistry of Materials / Advanced Functional Materials*, 2012.

2. P. M. Beaujuge, H. N. Tsao, M. R. Hansen, C. M. Amb, **A. Mavrinskiy**, W. Pisula, J.-L. Brédas, K. Müllen, J. R. Reynolds. Structure–performance relationships in organic photovoltaic cells based on soluble copolymers. *Journal of the American Chemical Society*, 2012.
3. H. N. Tsao, D. M. Cho, I. Park, M. R. Hansen, **A. Mavrinskiy**, D. Y. Yoon, R. Graf, W. Pisula, H. W. Spiess, K. Müllen. Ultrahigh mobility in polymer field-effect transistors by design. *Journal of the American Chemical Society*, 133(8), 2011.
4. **A. Mavrinskiy**, C. B. Nielsen, W. Pisula, J. Reynolds, K. Müllen. Influence of the alkyl mantle on the self-assembly of phenylene–thienylene-based oligomers. *Chemistry of Materials*, 23(8), 2139–2144, 2011.
5. H. Norouzi-Arasi, W. Pisula, **A. Mavrinskiy**, X. Feng, K. Müllen. Synthesis and self-assembly of macrocyclic mesogens based on 1,10-phenanthroline. *Chemistry — An Asian Journal*, 6(2), 367–371, 2011.
6. V. Kamm, G. Battagliarin, I. A. Howard, W. Pisula, **A. Mavrinskiy**, C. Li, K. Müllen, F. Laquai. Polythiophene:perylene diimide solar cells — the impact of core-substitution on photovoltaic performance. *Advanced Energy Materials*, 1(1), 79–83, 2011.
7. W. W. H. Wong, C.-Q. Ma, E. Mena-Osteritz, X. Wen, W. Pisula, **A. Mavrinskiy**, X. Feng, D. J. Jones, K. Müllen, K. P. Ghiggino, P. Bäuerle, A. B. Holmes. Fluorenyl hexa-*peri*-hexabenzocoronene–dendritic oligothiophene hybrid materials. *Chemistry — A European Journal*, 17(17), 4927–4937, 2011.
8. M. A. M. Leenen, F. Cucinotta, L. Viani, **A. Mavrinskiy**, W. Pisula, J. Gierschner, J. Cornil, A. Prodi-Schwab, H. Thiem, K. Müllen, L. De Cola. Electronic properties and supramolecular organization of terminal bis(alkylethynyl)-substituted benzodithiophenes. *Journal of Physical Chemistry B*, 114(45), 14614–14620, 2010.
9. R. Rieger, D. Beckmann, **A. Mavrinskiy**, M. Kastler, K. Müllen. Backbone curvature in polythiophenes. *Chemistry of Materials*, 22(18), 5314–5318, 2010.
10. M. Saleh, M. Baumgarten, **A. Mavrinskiy**, T. Schafer, K. Müllen. Triphenylene-based polymers for blue polymeric light emitting diodes. *Macromolecules*, 43(1), 137–143, 2010.
11. **A. Mavrinskiy**, E. Baitinger. Thermoelectric power in carbon nanotubes. *Semiconductors*, 43(4), 480–484, 2009.
12. N. Mavrinskaya, L. Pesin, M. Baumgarten, **A. Mavrinskiy**, E. Baitinger, S. Evsyukov. ESR studies of chemically dehydrofluorinated poly(vinylidene fluoride). *Magnetic Resonance in Solids*, 10(1), 31–38, 2008.
13. N. Mavrinskaya, I. Voinkova, E. Baitinger, **A. Mavrinskiy**. Specific features of the optical absorption in carbon nanosystems with hydrogen. *Physics of the Solid State*, 50(10), 1830–1835, 2008.

LANGUAGES

English · Russian · German · basic French