

## BANHART Florian

*Professeur*

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### **IPCMS - Département Surfaces et Interfaces (DSI)**

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### **Short Academic Biography:**

- ▶ PhD in physics at the University of Stuttgart 1988
- ▶ Research Scientist at the Max Planck Institute for Metals Research in Stuttgart 1989-1999
- ▶ Scientist at the University of Ulm 1999-2003
- ▶ Habilitation at the University of Ulm 2001
- ▶ Professor of Physical Chemistry at the University of Mainz 2003-2007
- ▶ Professor of Physics at the University of Strasbourg since 2007

### **Research Subjects:**

- ▶ Electron microscopy in materials science
- ▶ In-situ experimentation in the electron microscope
- ▶ Electron irradiation of materials
- ▶ Electrical properties of nanomaterials
- ▶ Nano-structuring of materials by electron beams
- ▶ Carbon nanomaterials: nanotubes, graphene, carbon onions, nanodiamonds
- ▶ Nanocomposites of graphitic particles and metals
- ▶ Junctions between nanomaterials
- ▶ Nucleation and growth of nanoparticles
- ▶ Nanosystems in non-equilibrium and self-organization phenomena
- ▶ Phase transformations in nanosystems
- ▶ High pressure phenomena at the nanoscale
- ▶ Defects, diffusion, and plasticity in nanometer-sized crystals

### **Selected Results (posters as pdf):**

[- Carbon nanotubes under electron irradiation](#)

[- Carbon onions as compression cells at the nanoscale](#)

[- Junctions between carbon nanotubes and metals](#)

[- Metal-filled carbon nanotubes under electron irradiation](#)

[- In-situ STEM: structuring of carbon nanomaterials at the sub-nanometer scale](#)

### **Selected Research Publications:**

F. Banhart, J. Kotakoski and A. Krasheninnikov  
"Structural defects in graphene" (review article)  
ACS Nano 5, 26 (2011)

J.A. Rodriguez-Manzo, C. Pham-Huu and F. Banhart  
"Graphene growth by a metal-catalyzed solid-state transformation of amorphous carbon"  
ACS Nano 5, 1529 (2011)

O. Cretu, A.V. Krasheninnikov, J.A. Rodríguez-Manzo, R. Nieminen and F. Banhart  
"Migration and localization of metal atoms on graphene"  
Physical Review Letters 105, 196102 (2010)

J.A. Rodríguez-Manzo, O. Cretu and F. Banhart  
"The trapping of metal atoms in lattice vacancies in graphene and carbon nanotubes"  
ACS Nano 4, 3422 (2010)

F. Banhart  
"Interactions between metals and carbon nanotubes: at the interface between old and new materials"  
Nanoscale 1, 201 (2009)

J.A. Rodríguez-Manzo, I.M. Janowska, C. Pham-Huu, A. Tolvanen, A.V. Krasheninnikov, K.H. Nordlund and F. Banhart  
"Growth of single-wall carbon nanotubes from sharp metal tips"  
Small 5, 2710 (2009)

J.A. Rodríguez-Manzo, M. Wang, F. Banhart, Y. Bando and D. Golberg  
"Multi-branched junctions of carbon nanotubes via cobalt particles"  
Advanced Materials 21, 4477 (2009)

J.A. Rodríguez-Manzo and F. Banhart  
"The creation of individual vacancies in carbon nanotubes by using an electron beam of 1 Å diameter"  
Nano Letters 9, 2285 (2009)

J. A. Rodríguez-Manzo, F. Banhart, M. Terrones, H. Terrones, N. Grobert, P.M. Ajayan, B.G. Sumpter, V. Meunier, M. Wang, Y. Bando and D. Golberg  
"Covalent Heterojunctions Between Metals and Carbon Nanotubes as Ultimate Nano-Contacts"  
Proceedings of the National Academy of Sciences 106, 4591 (2009)

L. Sun, A. V. Krasheninnikov, T. Ahlgren, K. Nordlund and F. Banhart  
"Plastic deformation of single nanometer-sized crystals"  
Physical Review Letters 101, 156101 (2008)

Y. Gan and F. Banhart  
"The Mobility of Carbon Atoms in Graphitic Nanoparticles Studied by the Relaxation of Strain in Carbon Onions"  
Advanced Materials 20, 4751 (2008)

F. Banhart (Editor)  
"In-situ Electron Microscopy at High Resolution" (review volume)  
World Scientific, Singapore, 2008

Y. Gan, L. Sun and F. Banhart  
"One- and two-dimensional diffusion of metal atoms in graphene"  
Small, 4, 587 (2008)

A. Krasheninnikov and F. Banhart  
"Engineering of nanostructured carbon material with electron or ion beams: from point defects to self-organization"  
Nature Materials 6, 723 (2007)

J.A. Rodríguez-Manzo, M. Terrones, H. Terrones, H.W. Kroto, L. Sun and F. Banhart  
"In-situ nucleation of carbon nanotubes by the injection of carbon atoms into metal particles"  
Nature Nanotechnology 2, 307 (2007)

L. Sun and F. Banhart  
"Graphitic onions as reaction cells on the nanoscale"  
Applied Physics Letters 88, 193121 (2006)

L. Sun, F. Banhart, A. Krasheninnikov, J.A. Rodríguez-Manzo, M. Terrones and P.M. Ajayan  
"Carbon nanotubes as high-pressure cylinders and nano-extruders"  
Science 312, 1199-1202 (2006)

F. Banhart  
"Irradiation of Carbon Nanotubes with a Focused Electron Beam in the Electron Microscope"  
Journal of Materials Science 41, 4505 (2006)

J.X. Li and F. Banhart  
"The deformation of single nanometre-sized metal crystals in graphitic shells"  
Advanced Materials 17, 1539 (2005)

F. Banhart, J.X. Li and A.V. Krasheninnikov  
"Carbon nanotubes under electron irradiation: stability of tubes and action as pipes for atom transport "  
Physical Review B (Rapid Commun.) 71, 241408 (2005)

F. Banhart, J.X. Li and M. Terrones  
"Cutting Single-Walled Carbon Nanotubes with an Electron Beam: Evidence for Atom Migration Inside Nanotubes"  
Small 1, 953 (2005)

P.M. Ajayan and F. Banhart  
"Nanotubes: strong bundles"  
Nature Materials (news and views) 3, 135 (2004)

J.X. Li and F. Banhart  
"The engineering of hot carbon nanotubes with an electron beam"  
Nano Letters 4, 1143 (2004)

F. Banhart  
"Formation and transformation of carbon nanoparticles under electron irradiation"  
Philosophical Transactions A 362, 2205 (2004)

X. W. Zhang, H.-G. Boyen, N. Deyneka, P. Ziemann, F. Banhart and M. Schreck  
"Epitaxy of cubic boron nitride on (001)-oriented diamond"  
Nature Materials 2, 312 (2003)

F. Banhart, E. Hernandez and M. Terrones  
"Extreme superheating and supercooling of encapsulated metals in fullerene-like shells"  
Physical Review Letters 90, 185502 (2003)

A. Krüger, M. Ozawa and F. Banhart  
"Carbon nanotubes as elements to focus electron beams by Fresnel diffraction"  
Applied Physics Letters 83, 5056 (2003)

M. Terrones, F. Banhart, N. Grobert, J.-C. Charlier, H. Terrones and P.M. Ajayan  
"Molecular junctions of single-walled nanotubes"  
Physical Review Letters 89, 075505 (2002)

F. Banhart  
"The formation of a connection between carbon nanotubes in an electron beam"  
Nano Letters 1, 329 (2001)

F. Banhart, J.-C. Charlier and P.M. Ajayan  
"The dynamic behaviour of nickel atoms in graphitic networks"  
Physical Review Letters 84, 686 (2000)

M. Zaiser, Y. Lyutovich and F. Banhart  
"The irradiation-induced transformation of graphite to diamond: a quantitative study"  
Physical Review B 62, 3058 (2000)

M. Terrones, H. Terrones, F. Banhart, J.-C. Charlier and P.M. Ajayan  
"The coalescence of single-walled nanotubes"  
Science 288, 1226 (2000)

Y. Lyutovich and F. Banhart  
"Low-pressure transformation of graphite to diamond under irradiation"  
Applied Physics Letters 74, 659 (1999)

F. Banhart  
"Irradiation effects in carbon nanostructures"  
Reports on Progress in Physics 62, 1181 (1999)

T. Füller, M. Konuma, J. Zipprich and F. Banhart  
"The critical thickness of silicon-germanium layers grown by liquid phase epitaxy"  
Applied Physics A 69, 597 (1999)

F. Banhart, Ph. Redlich and P.M. Ajayan  
"The migration of metal atoms through carbon onions"  
Chemical Physics Letters 292, 554 (1998)

F. Banhart, T. Füller, Ph. Redlich and P.M. Ajayan  
"The formation and self-compression of carbon onions"  
Chemical Physics Letters 269, 349 (1997)

F. Banhart  
"The transformation of graphitic onions to diamond under electron irradiation"  
Journal of Applied Physics 81, 3440 (1997)

M. Zaiser and F. Banhart  
"Radiation-induced transformation of graphite to diamond"  
Physical Review Letters 79, 3680 (1997)

F. Banhart and P.M. Ajayan  
"Carbon onions as nanoscopic pressure cells for diamond formation"  
Nature 382, 433 (1996)

**Current Research Projects:**

UTEM (Equipex) NANOCNTACTS (ANR)

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