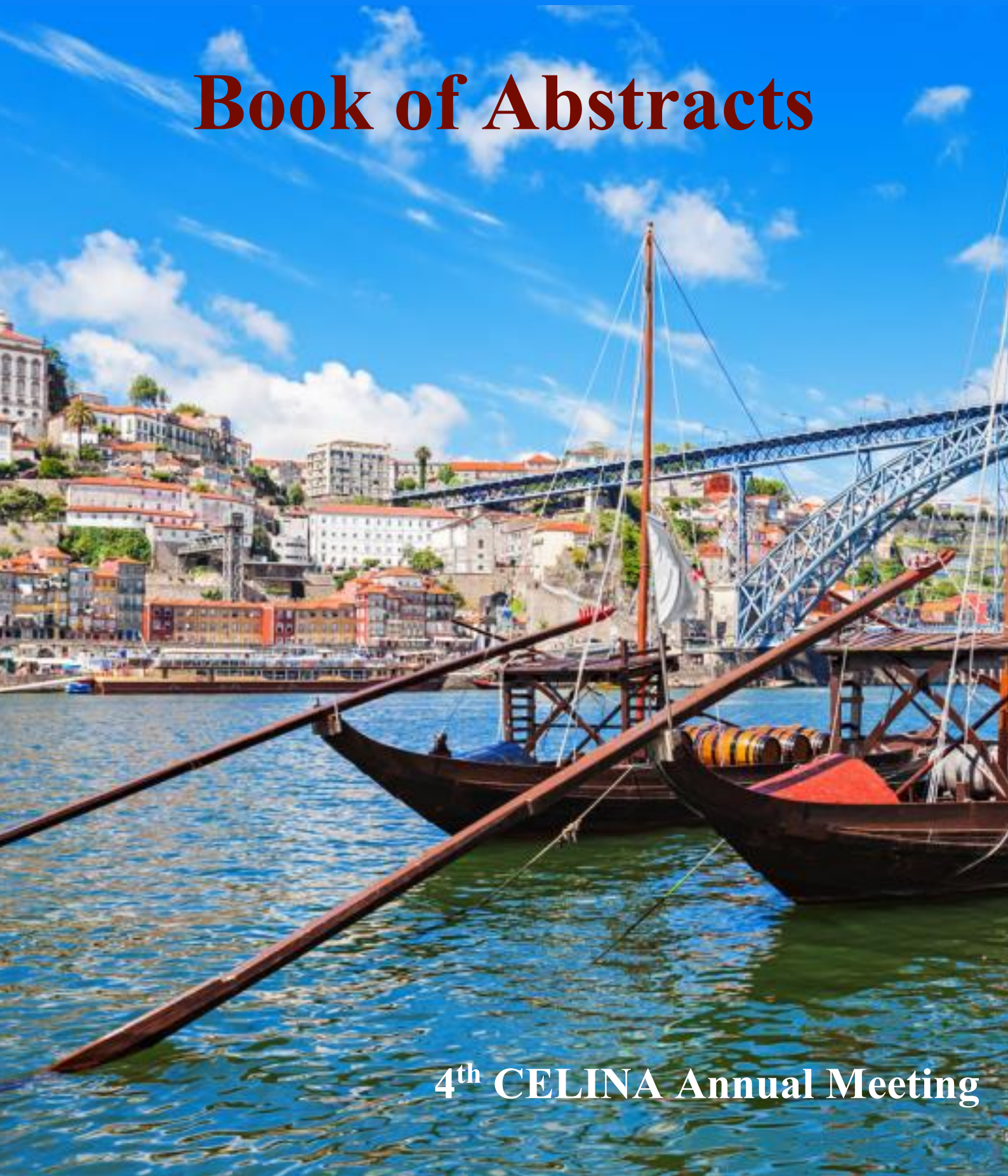
CELINA 2017

cost
EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

Chemistry for ELectron-Induced NAnofabrication (CELINA)
COST Action CM1301

Porto 13-16 September 2017

Book of Abstracts



4th CELINA Annual Meeting

SCIENTIFIC PROGRAMME OF THE 4th CELINA 2017 annual meeting

Wednesday 13th September

14:00 – 19:00 REGISTRATION AND WELCOME RECEPTION (Seminário de Vilar, Porto)

Thursday 14th September

08:30 – 09:00 **Opening Remarks**

09:00 – 09:20 **CELINA overview and synthetic perspectives**
Chair: Kees Hagen
Petra Swidereck (*University of Bremen*)
"COST Action CM1301 – CELINA: What has been achieved and what lies ahead?"

09:20 – 09:50 **Novel developments in FEBID and beyond**
José Maria de Teresa (*University of Saragoza)*
"Novel developments in FEBID for magnetic materials"

09:50 – 10:20 **Armin Gölzhäuser** (*University of Bielefeld*)
"Imaging, modification and analysis of nanostructures with the helium ion microscope"

10:20 – 10:40 **Teodor Gotszalk** (*Wrocław University of Technology)*
"Novel devices including functional FEBID structures"

10:40 – 11:10 COFFEE BREAK

11:10 – 11:40 **Carboxylate precursors**
Chair Heinrich Lang
Iwona Szymanska (*Nicolaus Copernicus University in Toruń*)
"Overview of properties and synthetic strategies towards carboxylate FEBID precursors"

11:40 – 12:00 **Ivo Utke** (*EMPA – Swiss Federal Laboratories for Material Science and Technology)*
"Gas assisted focused electron beam induced deposition with low volatility precursors"

12:00 – 12:20 **Katarzyna Madajska** (*Nicolaus Copernicus University in Toruń*)
"Perfluorinated silver (I) carboxylate compounds for focused electron beam induced deposition (FEBID)"

12:20 – 12:50 **Lionel Amiaud** (*University of Paris-Sud*)
"New FEBID copper precursor under high vacuum for the study of chemical processes induced by low energy electron irradiation"

12:50 – 14:00 LUNCH

Bimetalic precursors

14:00 – 14:30 Chair: Nigel Mason

Sven Barth (*Technical University of Vienna)*
"Synthesis of heteroleptic and metallic precursors for focused electron beam induced deposition"

14:30 – 15:00 **Oddur Ingólfsson** (*University of Iceland*)
"Electron induced fragmentation of bimetallic focused electron beam induced deposition precursors"

15:00 – 15:30 **Michael Huth** (*Goethe University)*
"Complex 3D magnetic nanostructures prepared by FEBID"

15:30 – 15:50 **Ragesh Kumar** (*University of Iceland*)
"Electron induced surface reaction of bimetal FEBID precursor molecules $HFeCo_3(CO)_{12}$ and $H_2FeRu_3(CO)_{13}$"

15:50 – 19:00 Poster Session
COST Action CM1301 CELINA MC Meeting

Friday 15th September

Neutral excitation and dissociation

09:00 – 09:30 Chair: Oddur Ingólfsson
Juray Fedor (*Czech Academy of Sciences*)
"Neutral dissociation: review of experimental approaches"

09:30 – 10:00 **Matija Zlatar** (*University of Belgrade)*
"The role of electronic excitations in FEBID precursors"

10:00 – 10:20 **Juraj Orzsagh** (*Comenius University*)
"Electron induced fluorescence – detection of neutral fragments"

10:20 – 10:40 **Anita Ribar** (*Comenius University and University of Innsbruck*)
"The role of electron self-scavenging in aggregates of $Cr(CO)_6$"

10:40 – 11:10 COFFEE BREAK

11:00 – 11:40 **Novel developments in FEBID and beyond**
Chair: Armin Gölzhäuser
Gregor Hlawaczek (*Institute for Ion Beam Physics and Materials Research)*
"Nano-fabrication with the helium microscope"

11:40 – 12:10 **CELINA overview and synthetic perspectives**
Lisa McElwee-White (*University of Florida)*
"Mechanism-based design of precursors for FEBID"

12:10 – 12:50 Discussion on future activities
COST Action CM1301 CELINA WG Meetings

12:50 – 14:00 **LUNCH**
14:00 – 19:00 **Walking tour**
19:00 **CONFERENCE DINNER**

Saturday 16th September

09:00 – 09:30
Process gases for deposit purification and lithography
Chair: Ivo Utke
Mostafa M. Shawarav (*Institute of solid state electronics*)
"An overview of in-situ ad ex-situ purification strategies for FEBID gold nanostructures"

09:30 – 10:00 **Anpan Han** (*Technical University of Denmark)*
"Organic ices resists"

10:00 – 10:20 **Markus Rohdenburg** (*University of Bremen*)
"Expanding and understanding water-assisted purification procedures: a case study of the potential FEBID precursor $(EtCp)_2Ru$"

10:20 – 10:40 **Carboxylate precursors**
Katja Höflich (*EMPA – Swiss Federal Laboratories for Material Science and Technology*)
"Direct electron beam writing of silver-based nanostructures"

10:40 – 11:10 **COFFEE BREAK**

11:10 – 11:30
Improved control over electron-driven processing
Chair: Juraj Fedor
Janina Kopyra (*Siedlce University)*
"Low energy electron triggered fragmentation of metal acetylacetonates"

11:30 – 11:50 **Neutral excitation and dissociation**
Sylwia Ptasinska (*University of Notre Dame*)
"Instrumentation for neutral radical detection from gas-phase molecular dissociative electron attachment"

11:50 – 12:10 **Improved control over electron-driven processing**
Gian Carlo Gazzadi (*S3 center – Nanoscience Institute)*
"FEBID of W and Pt precursors at very low energy"

12:10 – 12:30 **Sascha Koch** (*University of Bielefeld)*
"Amplified cross-linking efficiency of SAMs through targeted DEA for production of CNMs"

12:30 – 12:50 **Concluding remarks**
12:50 – 14:00 **LUNCH**
14:00 **Departure**

T-11: Complex 3D magnetic nanostructures prepared by FEBID

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Building nanotechnological analogues of naturally occurring magnetic structures has proven to be an extremely powerful approach to studying topics like geometry-induced magnetic frustration and to provide model systems for statistical physics. Moreover, it practically allows to engineer novel physical properties by realizing artificial lattice geometries that are not accessible via natural crystallization or chemical synthesis. This has been accomplished with great success in the field of two-dimensional (2D) artificial spin ice systems over the last decade with important branches also reaching into the field of novel magnetic logic devices, such as, magnetic quantum cellular automata. Although first proposals have been made to advance into three-dimensions (3D), established nano-fabrication pathways based on sophisticated electron beam lithography have not been adapted to obtain free-form 3D nanostructures. Here we demonstrate the direct-write fabrication of freestanding, ferromagnetic 3D nano-architectures, which does, amongst other things, allow for full control over the degree of magnetic frustration. In particular, we have realized free-form shapes featuring three- and four-edge magnetic vertex types as important building blocks for more complex, geometrically frustrated 3D vertex configurations. By employing micro-Hall sensing based on a two-dimensional electron gas, we have determined the magnetic stray field generated by our free-form structures in an externally applied magnetic field. Taking information from microstructure analysis into account, we have performed micromagnetic and macro-spin simulations that allow us to deduce the spatial magnetization profiles in the structures and analyze their switching behavior based on the single-domain magnetic element paradigm followed in 2D artificial spin ice structures. In geometrically frustrated systems, the occurring magnetic configurations as well as the transitions between them are controlled by both, the topology and geometry of the interacting magnetic elements. Our approach allows for the fabrication and magnetic characterization of arrays of free-form 3D structures. Furthermore, the 3D elements made of magnetic material can be combined with other 3D elements of different chemical composition and intrinsic material properties, such as superconducting, plasmon-active, or dielectric materials. We therefore expect that the direct-write approach presented here will inspire innovative free-form design-oriented ideas to engineer nanoscale systems with new emergent physics.