

TOPICALITIES

Edited by Markéta Držková

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News & more

The CIE activities in 2024



The current scope, structure, role and objectives of the International Commission on Illumination have recently been presented in a series of interviews with CIE President Jennifer Veitch and CIE Education, Technical and Standards Vice-Presidents in the LED Professional Review Magazine. The CIE Research Strategy 2023–2027, also presented in a webinar organised in October 2024, takes into account two overarching themes related to digital transformation and efforts towards inclusive, equitable lighting and defines six topical themes: (i) Advances in measurement & calibration, (ii) Integrative lighting for people, (iii) Ecologically respectful, high-quality exterior lighting, (iv) Fundamentals of photobiology for agriculture and aquaculture, (v) Enabling the application of safe & beneficial optical radiation, and (vi) Measuring, modelling, perceiving and reproducing colour. This last one also considers the visual appearance information for augmented, virtual and extended reality devices and the challenges of surface colorimetry and colour reproduction in 3D printing.

In August, the third edition of the CIE Position Statement on Integrative Lighting – Recommending Proper Light at the Proper Time was published. While the research into related phenomena still continues, although advancing rapidly, the key message is quite simple: the light exposure depends on light levels and spectra of all sources in proximity, both direct and reflected, and very high light exposure during the day, a much lower level in the evening, and near-darkness during sleep strongly support the circadian rhythm, and thus the physiological processes essential for well-being and the performance during the day. The topics of ‘Light Pollution’ and ‘Light and Health’ are also central to the CIE project ‘Understanding Science – Understanding Light’, running from 1 January 2025 to 30 June 2026 to foster public understanding of the impact of light on human lives.

Among the publications, the Proceedings of the 30th Quadrennial Session of the CIE were published as CIE x050:2023 at the very end of 2023, with a selection of 220 papers presented during the three-day technical conference (1 invited, 68 oral and 151 poster presentations). The papers are also available individually, 40 of them for free, e.g. those dealing with the effect of surface curvature on specular gloss evaluations, Hunt effect, or spectrally dependent non-linearity of charge accumulating pixel matrix sensors. The standards and reports published in 2024 include the revised standard ISO/CIE 10916:2024 Light and lighting – Energy performance of lighting in buildings – Calculation of the impact of daylight utilization, which helps optimising the energy demand for electric lighting and cancels and replaces ISO 10916:2014, the new technical report CIE 252:2024 Assessment of discomfort glare from daylight in buildings, the new standard CIE S 027:2024 Photometry of road illumination devices, light-signalling devices and retroreflective devices for road vehicles, the third edition of the joint standard defining photocarcinogenesis action spectrum of non-melanoma skin cancers, ISO/CIE 28077:2024, and four CIE documents prepared under Division 1, Vision and Colour, and presented in more detail on the next page as most relevant to the scope of JPMTR.

Fogra research projects and publications in 2024



The new projects that started in 2024 deal with image analysis

using the metric imitating the characteristics of the human visual system for a more comprehensive and automated assessment of colour deviations of printed plastics and with colour matching for illumination without a UV component, which is typical for the sources based on light-emitting diodes.

The projects ending in 2024 covered four different topics. One was studied in partnership with the Fraunhofer Institute for Computer Graphics Research IGD and the Institute for Laser Technologies in Medicine and Metrology at the University of Ulm (ILM). It concerned 3D soft-proofing for an accurate simulation of volumetric light transport effects and geometric errors in 3D prints. The approach involved developing renderers for the correct visualisation of the translucency of 3D-printed objects, simplifying the characterisation of 3D-printing materials by estimating the optical properties using spectrophotometric measurements and deep-learning algorithms, and advancing colour communication in full-colour 3D printing by creating the exchange colour space and other standardisation efforts. The project outcomes include a beta version of the 3D Design RGB ICC profile and settings recommendations for translucency in Blender.

The aim of another project was to develop a cross-process print quality assessment procedure employing a simple score calculated from various image quality attributes. The approach was based on collecting and analysing the existing metrics, producing test prints with controlled variations and defining criteria for the planned score.

The third project completed recently by Fogra was focused on correlating visual and metrological characterisation of metallic effects to increase process reliability in packaging printing. Pairwise visual comparisons of the metallised prints with various characteristics under different lighting conditions enabled the creation of a sensitively equidistant scale for the metallic effect. Also, the relevant parameters of these samples were measured, and their relationship with the strength of the metallic effect was evaluated using regression analyses to enable an objective evaluation of metallised products. Most selected parameters correlated well with the visual assessment, except those measured with a multi-angle colorimeter, which was attributed to the relatively large distance from the specular angle.

The fourth of the projects ending in 2024 aimed to increase the economic efficiency and sustainability of print production with heatset offset presses, either by using the sources with UV light-emitting diodes or operating drying units with unheated air. The approach was based on acquiring and comparing the production data needed to develop a calculator of costs and CO₂ emissions for the processes considered. Another aspect was an experimental study of the suitability of papers for the so-called coldweb process.

Among other activities last year, Fogra published its third white paper, 'Metal particles in offset printing inks', summarising the research on the presence of metal shavings in the inks and their effects on metallic surfaces of dampening rollers. The white paper presents the developed process for extracting ferromagnetic particles, its application to ink series from four major manufacturers, and analyses of metal shavings and the surface of rollers. The results show that the metal particles, always present only in small quantities and having lower hardness than roller surfaces, cannot damage the latter. The June issue of Fogra Extra (No. 43) provides the fundamentals for reliable proofing of spot colours, both solid inks and their halftone tints.

ISO/CIE 11664-5:2024

Colorimetry – Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram

This document specifies the procedures for calculating the coordinates of the approximately uniform CIELUV colour space, the corresponding correlates of lightness, chroma, saturation and hue as well as Euclidean colour difference values representing the relative perceived magnitude, and a related chromaticity diagram. The standard applies to tristimulus values based on the CIE 1931 or CIE 1964 colour-matching functions and the specification of colour stimuli perceived as belonging to a reflecting or transmitting object, including self-luminous displays simulating such objects. To colour stimuli perceived as belonging to a primary light source or specularly reflected light, only the u', v' uniform chromaticity scale diagram and the correlates of hue and saturation apply. This second edition from June 2024 cancels and replaces the 2016 version. It was prepared by CIE in cooperation with ISO/TC 274, Light and lighting, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 139, Paints and varnishes. The changes include text, formulae and bibliography updates.

ISO/CIE 23603:2024

Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour

This document deals with quantifying the suitability of the spectral irradiance distribution of a daylight simulator for the visual appraisal and measurement of colours of fluorescent or non-fluorescent specimens. It specifies the maximum permissible deviation of the chromaticity of the simulator from the chromaticity of the illuminant being simulated (CIE standard daylight illuminant D50 or D65 or CIE daylight illuminant D55 or D75). The method uses pairs of virtual specimens that are metameric matches under the CIE daylight illuminant when evaluated with the CIE 1964 standard colorimetric observer; the evaluation is based on the special metamerism index for visible or ultraviolet range, quantifying the mismatch between these pairs with specified reflecting and fluorescing properties when illuminated by the daylight simulator tested. This joint standard, published in October 2024, cancels and replaces ISO 23603:2005; the new version includes updated terms, definitions and normative references.

CIE 253:2024 – Overview of Methods for Evaluating Colour Rendition of White-Light Sources beyond Colour Fidelity

Seven methods described in this technical report include Colour Quality Scale, Colour Rendering Index based Colour Rendition Properties, Colour Rendering Vectors and Colour Saturation Icon, Feeling of Contrast Index, IES TM-30 Method, Memory Colour Rendition Index, and Preference Index of Japanese Skin Colour.

CIE 254:2024 – A roadmap toward basing CIE colorimetry on cone fundamentals

This technical report summarises the main steps for developing a new system, explicitly considering the impacts of normal variations of the cone fundamentals due to age, field of view, and individual diversity, which requires to create colorimetric measures and approximately uniform colour space based on cone fundamentals, expand their wavelength range and study their diversity and its colorimetric effects.

Bookshelf

Colour Futures

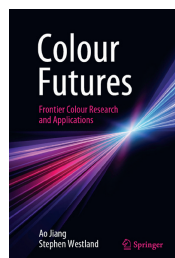
Frontier Colour Research and Applications

This new book was published as a fifth volume in the Vision, Illusion and Perception series. It deals with colour from many perspectives, explaining and illustrating a wide range of its theoretical and practical aspects.

Seven chapters provide the fundamental background of colour perception, representation, and measurement, as well as its psychological and cultural effects and meanings. Here the text covers the elements of colour vision and blindness, colour attributes, the importance of colour vision in different fields, CIE chromaticity diagrams, $L^*a^*b^*$ and colour difference, spectral reflectance measurement, illuminants, light sources, colorimetry, metamerism and measurement instruments. Also, it discusses retinal imaging, colour constancy, contrast and assimilation, colour appearance models, colour harmony and mixing, colour preference and the influencing factors, including the ecological valence theory with its current limitations, and the impact of colour on human emotions and culture, behaviour, work performance and physiology, such as emotion and sleep cycle regulation or cognition and attention.

The following three chapters focus on using and reproducing colour in digital imaging, on the internet and in the metaverse of virtual and augmented realities (AR/VR), presenting the related terms, principles and challenges. The basics introduced in these sections range from colour gamut and fidelity, colour palettes and test charts, optical image formation, colour imaging tools, RGB and CMYK models, colour management systems, image quality and various colour-correction methods to colour standards and models in virtual environments, the influence of light and materials on virtual colour, the AR/VR display technology, and colour calibration of these devices. The more advanced tasks and concepts include infrared image colouring, the relationship between colour and user behaviour, inclusive colour design, the role of colour in virtual scenes in terms of information transmission and visualisation, navigation, interaction and immersion, the use of immersive virtual environments for colour research, and colour coordination in augmented reality.

In the remaining part of the book, two chapters explore colour in health design and the built environment, discussing the effects of colour on cognition, behaviour and productivity, non-visual effects of colour, psychological, spiritual and physiological effects of environmental colours, enhanced navigation, and adaptive design, among others. Two chapters on artificial intelligence and robotics describe, e.g., the use of machine learning for colour segmentation and transforms, generative artificial intelligence and imaging, colour-optimised image recognition, robot motion based on colour detection, and robot colour effects on humans. The last chapter outlines colour trends and forecasting.



Authors: Ao Jiang, Stephen Westland

Publisher: Springer

1st ed., December 2024

ISBN: 978-3-031-70919-7

351 pages, 189 images

Hardcover

Available also as an eBook



Tradition and Science of Persian Ink Making
Ingredients and Recipes

Author: Sadra Zekrgoo

Publisher: Springer
1st ed., June 2024
ISBN: 978-3031520709
190 pages, 265 images
Hardcover
Also as an eBook



The author of this book builds on long-term, ongoing research into the topic. This volume presents a comprehensive account of constituents and recipes of Persian inks identified in 15 manuscripts studied. The ingredients are classified into seven groups. The largest one comprises almost 50 different colourants, from lamp black, vitriols and copper to henna, indigo, woad and myrtle, up to pigeon's blood and fish oil, to name a few. The remaining ones include binding media, thickening agents, aromatics, preservatives, glossing agents and mordants, mostly with five options each; for example, sugar, honey, Egyptian sugar candy, gold and silver to increase the sheen or lustre. Among the recipes, besides black inks and coloured inks or liqs, sympathetic, waterproof, colour-increasing, water-floating and other special inks, e.g. for printing or textiles, are described.

Artificial Intelligence in Manufacturing
Applications and Case Studies

*Editors: Masoud Soroush,
Richard D. Braatz*

Publisher: Academic Press
1st ed., January 2024
ISBN: 978-0323991353
340 pages, Softcover
Also as an eBook

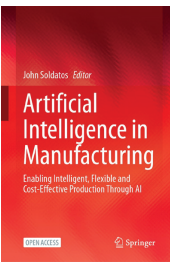


Ten case studies included in this book present, for example, implementing artificial intelligence for paints and coatings manufacturing, plasma-assisted semiconductor manufacturing and advanced manufacturing of touch-sensitive textiles.

Artificial Intelligence in Manufacturing
Enabling Intelligent, Flexible and Cost-Effective Production Through AI

This open-access book documents how the development of artificial intelligence (AI) technologies and applications follows and facilitates the transition of digital manufacturing systems toward human-centric, trustworthy solutions of Industry 5.0. In 27 chapters, it identifies the existing limitations and presents the most advanced systems currently deployed in Industry 4.0, along with the novel, complex AI architectures and approaches required in the emerging era.

The content is organised into three parts. The first describes suitable architectures, business models and semantic modelling techniques. The second deals with multi-agent systems, digital twin frameworks, the use of conversational agents, and approaches based on reinforcement learning and decentralised technical intelligence. The last part presents the trusted, explainable, and human-centred AI systems. Examples include human activity recognition utilising wearable sensors, object detection for human–robot interaction and worker assistance systems, anomaly detection in manufacturing, and different applications of explainable AI, e.g. for visual inspection or process and product quality optimisation.



Editor: John Soldatos

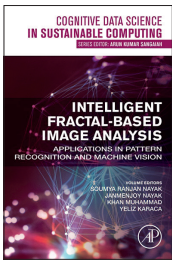
Publisher: Springer
1st ed., February 2024
ISBN: 978-3-031-46451-5
532 pages, 175 images
Hardcover
Available also as an eBook

Intelligent Fractal-Based Image Analysis
Applications in Pattern Recognition and Machine Vision

The basic concepts presented in this volume include pattern recognition, image compression and texture segmentation using fractal features, feature extraction using fractal dimensions, and intelligent approaches for the analysis of fractal features. The individual chapters deal with the analysis of Mandelbrot set fractal images based on machine learning, chaos-based image encryption, classifying images based on fractal features, evaluating image characteristics by the normalised fractal-based technique, fractal-based sequence learning, wavelets for anisotropic oscillations in nanomaterials, comparative analysis of approaches to optimise fractal image compression, and several example applications in medical imaging.

*Editors: Soumya R. Nayak, Janmenjoy Nayak,
Khan Muhammad, Yeliz Karaca*

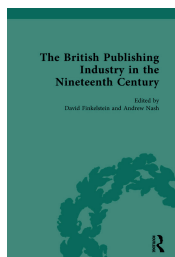
Publisher: Academic Press
1st ed., May 2024
ISBN: 978-0-443-18468-0
318 pages
Softcover
Available also as an eBook



The British Publishing Industry in the Nineteenth Century
Volume I: The Structure of the Industry
Volume II: Publishing and Technologies of Production
Volume III: Authors, Publishers and Copyright Law
Volume IV: Publishers, Markets, Readers

This four-volume work provides an in-depth insight into the transformation of the British publishing industry during the 19th century, as documented by contemporary sources showing how it was driven by the interplay of changes in many related areas, from evolving technology, production mechanisation and new modes of transport, communication and retail to reforms in education and copyright legislation, professionalisation, new business models, market internationalisation and increased demand for printed matter, all of which led to a mass reading public thanks to the growing affordability of books and periodicals, as well as their availability in libraries.

The first volume deals with the book trade operation and economic aspects, the government control through taxes and legal deposit requirements, and the situation in bookselling, including the discount question discussion. The second volume describes technologies and processes, from improved paper quality to monotype and linotype machines, and also presents printing offices and working practices. The third volume is dedicated to authors, publishers, agents, copyright law, and the society of authors. The fourth volume discusses the price of books and their circulation, popular publishing and reading, railway bookstalls, periodical markets, circulating libraries, the fiction market, and the impact of obscenity laws on the book trade.



Editors: David Finkelstein, Andrew Nash

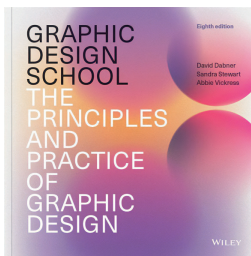
Publisher: Routledge
 1st ed., March 2024
 ISBN: 978-0-367-56522-0 (set)
 1766 pages
 Hardcover
 Available also as an eBook

Graphic Design School
The Principles and Practice of Graphic Design

The structure of the 8th edition of this introductory book on graphic design remained unchanged, with the methods of how to approach design and basics of composition, typography and colour in the first part and selected software tools and advice on individual steps in designing common printed and digital media in the second part, but the content was updated with new images, examples and recommended reading.

*Authors: David Dabner,
 Sandra Stewart, Abbie Vickress*

Publisher: Wiley
 8th ed., December 2023
 ISBN: 978-1-394-18566-5
 208 pages
 Softcover
 Available also as an eBook



The Printing Unwins
A Short History of Unwin Brothers:
The Gresham Press (1826–1976)

Author: Philip Unwin

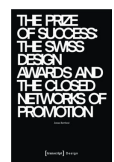


Publisher: Routledge
 1st ed., October 2023
 ISBN: 978-1032593623
 195 pages
 Hardcover
 Also as an eBook

This book, first published in 1976 and now available as a part of the Routledge Revivals book series, presents the history of the Unwin family printing company over 150 years, from its founding by Jacob Unwin in London to the decades at new premises in Woking, including the last dozen years under new ownership. It shows the dedication to typography, printing and progress while reflecting the many economic, social and technological changes, also documented by illustrations with the equipment used in different periods, from the original composing room to Monotype keyboards and casters, perfectors and folding machines, up to a Compuscan machine for the optical character recognition, paper tape input keyboards and Linotron phototypesetting device.

The Prize of Success
The Swiss Design Awards and the Closed Networks of Promotion

Author: Jonas Berthod



Publisher: Transcript
 1st ed., May 2024
 ISBN: 978-3837671919
 256 pages, 96 images
 Softcover
 Also as an eBook

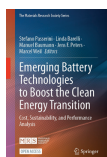
In this book, the author analyses the role of the Swiss Design Awards in graphic design promotion and the definition of “good” design. The text tracks their evolution and influence, as well as the interests and attitudes of various parties involved, and documents the networks formed around the awards in different periods, discussing the benefits and risks implied by closing the loop.

Emerging Battery Technologies to Boost the Clean Energy Transition

Cost, Sustainability, and Performance Analysis

*Editors: Stefano Passerini,
Linda Barelli, Manuel Baumann,
Jens Peters, Marcel Weil*

Publisher: Springer
1st ed., February 2024
ISBN: 978-3031483585
353 pages, 53 images
Hardcover
Also as an eBook



In this book, over 50 contributors provide an interdisciplinary view on the topic. The chapters in the first three parts address mobility and future trends, circular economy for batteries, system perspective for a clean energy transition, projected global demand for energy storage, other energy storage technologies, advantages and importance of batteries in the energy transition, segmentation of battery market and its outlook. Two parts focus on the performance and cost of present batteries, raw materials and recycling of lithium-ion batteries, and emerging battery chemistries for closed and open battery systems. The last part deals with prospective assessments of emerging batteries, methodological challenges, life-cycle assessments, techno-economics analyses, social implications and approaches, and a multicriteria decision analysis.

Smart Textiles from Natural Resources

Editor: Ibrahim H. Mondal

Publisher: Woodhead Publishing
1st ed., April 2024
ISBN: 978-0443154713
926 pages, Softcover
Also as an eBook



This extensive book covers various types of smart textiles, e.g. stimuli-responsive or electrically conducting, materials and technologies for their production, including printing, and their applications in different areas.

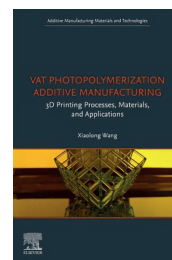
Vat Photopolymerization Additive Manufacturing

3D Printing Processes, Materials, and Applications

This book focuses on recent progress in 3D printing technologies based on vat photopolymerisation and their applications in various areas. Three chapters introduce the fundamental principles and components, the classification according to the type of light source and geometric configuration, the specifics of two-photon polymerisation and techniques using multiple beams, materials or wavelengths, including the strengths and weaknesses of the individual options, the photopolymerisation mechanism and composition of UV-curable resins, the relationship between structure and mechanical properties, and the possibility of optimising the process and output by controlling the involved interfaces. The following chapters deal with the manufacturing of various plastics, hydrogels, stimuli-responsive polymers, ceramics, electronics, metamaterials and bio-inspired structures, the advantages of surface functionalisation and relevant surface engineering methods, the impact of vat photopolymerisation 3D printing in the fields of engineering and bioengineering, and a brief outline of the trends and prospects.

Editor: Xiaolong Wang

Publisher: Elsevier
1st ed., April 2024
ISBN: 978-0-443-15487-4
518 pages
Softcover
Available also as an eBook



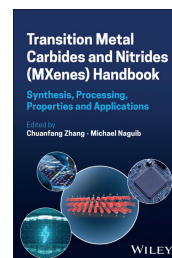
Transition Metal Carbides and Nitrides (MXenes) Handbook

Synthesis, Processing, Properties and Applications

With almost 80 contributors from across the globe, this handbook brings a comprehensive account of the MXene family of 2D materials. After the introduction, one part provides the guidelines on synthesising MXene precursors, use of fluorine, molten salt etching, intercalation of ions and molecules, and MXenes with multiple M elements. Further, it discusses MXene thermal and chemical stability, degradation mechanism, handling and storage, structural confirmation and morphological investigation, surface terminations, delamination and surface functionalisation. Finally, it deals with MXene dispersion stability, rheology and ink formulation for printing and wet coating, as well as 3D printing of MXenes and their assembling from liquid to solid. The following part focuses on the optical, optoelectronic and mechanical properties of MXenes and their prediction, while the last presents MXene applications in supercapacitor devices, batteries, electromagnetic interference shielding, electronics, sensors, environmental treatments and healthcare.

Editors: Chuanfang Zhang, Michael Naguib

Publisher: Wiley
1st ed., June 2024
ISBN: 978-1-119-86949-8
784 pages
Hardcover
Available also as an eBook



Bookshelf

Academic dissertations

3D Printing and Stretchable Electronics

The research within this thesis focused on stretchable electronics comprising rigid module islands and their stretchable interconnections on deformable substrates, particularly the possibilities to improve their electrical performance and applicability by reducing the mechanical differences of the three main components. In order to achieve more robust systems, the work employed 3D printing and explored joining rigid module islands on a deformable substrate with different adhesives, designing protective structures, reinforcing screen-printed stretchable interconnections, and integrating carbon-based fibre cloth into composite matrices of electronics components.

After introducing the thesis and its aims, one chapter of the dissertation describes rigid, flexible, stretchable and textile substrates, module islands, their adhesion, bonding methods and the impact of stress concentration, rigid shaped copper foil interconnections, rigid and deformable printed interconnections, fibre-based interconnections and stretchable interconnections failure mechanisms. Also, it presents fused-filament fabrication for 3D printing of stretchable electronics, structure and stretchability of 3D-printed objects, as well as electronics and stretchable electronics prepared by this and other 3D-printing techniques. The following two chapters present and discuss the results. A nonstructural adhesive provided the best results when testing different non-conductive adhesives to fix common reinforced epoxy laminate and 3D-printed polylactic acid boards on thermoplastic polyurethane film. Further, the stress concentration around the rigid islands could be controlled by using suitable protective structures. Similarly, the support structures 3D-printed with thermoplastic polyurethane filament improved the stretchability of meander-shaped interconnections. Finally, it was shown that stretchable 3D-printed structures for wearable electronics could be produced by inserting permeable carbon fibre cloth plies inside a thermoplastic polyurethane matrix during 3D printing, and the use of these samples as a 3D-printed strain sensor was demonstrated.

Doctoral thesis – Summary

Author:

Teemu Salo

Speciality field:

Electrical Engineering

Supervisor:

Jukka Vanhala

Defended:

*28 March 2024, Tampere University,
Faculty of Information Technology
and Communication Sciences
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Further reading:

*[https://trepo.tuni.fi/
handle/10024/154978](https://trepo.tuni.fi/handle/10024/154978)*

Advances in Additive Manufacturing of Organic Electrochemical Transistors

This work contributes to the progress in printed organic electrochemical transistors towards better performance and higher sustainability, facilitating their broader use in bioelectronic and logic circuit applications. In particular, the research comprised optimising printing strategies and device architectures, using novel channel materials and ink formulations, and integrating organic electrochemical transistors into all-printed sensor platforms.

Four chapters of the dissertation provide the background on relevant materials and printing technologies for additive manufacturing of organic electronics, especially organic electrochemical transistors, various aspects of these devices, and characterisation methods employed in the work. The text describes the structure and properties of organic semiconducting materials, charge transport in both polymeric and molecular organic semiconductors, and channel materials for organic electrochemical transistors, including the

Doctoral thesis – Summary

Author:

Anatolii Makhinia

Speciality field:

Organic Electronics

Supervisors:

*Peter Andersson Ersman
Valerio Beni
Simone Fabiano
Daniel Simon*

Defended:

*24 May 2024, Linköping University,
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Norrköping, Sweden*

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pgBTTC polymer, i.e. poly([4,4'-bis(2-(2-(2-methoxyethoxy)ethoxy)ethoxy)-2,2'-bithiophene-5,5'-diyl]-*alt*-[thieno[3,2-*b*]thiophene-2,5-diyl]). Among additive manufacturing technologies, screen printing, inkjet printing and aerosol-jet printing are presented, together with their advantages and limitations with respect to printed electronics. The chapter dedicated to organic electrochemical transistors introduces their history, working principle and mode of operation, performance metrics, device architectures, channel geometries, gate electrode materials and electrolytes. Also, it discusses the effect of solvent substitution on device performance and describes the example applications in logic circuits and ion-selective sensors. Finally, one chapter summarises the published studies. Combining the screen printing and aerosol-jet printing for the fabrication of organic electrochemical transistors enabled a significant decrease in the channel width and thus improved the switching response, demonstrated by the operational frequency of inverters beyond 100 Hz and self-oscillation frequency of the five-stage ring oscillator of about 60 Hz. By integrating transistors with other printed components, it was possible to develop two types of sensor platforms; one combined the transistor with a screen-printed piezoelectric sensor for monitoring electrophysiological signals, and the other integrated the transistor into a 3D-printed microfluidic circuit. The pgBTTC-based ink formulation with a biodegradable and non-toxic dihydrolevoglucosenone solvent was successfully used for a novel all-printed accumulation-mode vertically stacked organic electrochemical transistor.

Further reading:
DOI: 10.3384/9789180756167

Doctoral thesis – Summary

Author:
Mia Klemenčić

Speciality field:
Graphic Technology

Supervisors:
Ivana Bolanča Mirković
Nenad Bolf

Defended:
28 August 2024, University of Zagreb,
Faculty of Graphic Arts
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The Optimization of Sustainable Procedures for the Designing and Recycling of Pharmaceutical Cardboard Packaging

This thesis explored the possibilities of increasing the sustainability of pharmaceutical packaging by optimising its design in terms of better recyclability and circularity without deterioration in packaging quality. It involved analysing the processes of packaging manufacturing and recycling to identify the key factors affecting the relevant properties of recycled paper. The experimental work comprised preparing samples corresponding to the main stages of cardboard packaging production and the presence of lamination, their recycling with three different flotation methods, producing laboratory sheets of paper and flotation foam, and evaluating their optical properties and metal traces in samples. The research also dealt with a conceptual solution for a sustainable pharmaceutical product. The approach was based on defining the requirements and specifications and developing a calculation model for optimising the use of adhesive and lamination when considering different design concepts.

Two chapters of the dissertation provide an overview of paper production and properties in general, the use of additives, adhesives, coatings and multilayer structures with their impact on paper recycling, paper packaging, specific requirements in the case of food and pharmaceutical packaging, and other considerations related to the latter one. The following five discuss the concerns regarding heavy metals and other contaminants in food packaging materials, their migration and assessment, various stages and aspects of paper recycling, waste management, circular economy, sustainability, life-cycle assessment, eco-design and sustainable packaging, as well as current packaging trends, design optimisation and strategies for optimised use of adhesives and laminates in packaging. The remaining three chapters present methods, materials and obtained results. It was shown that understanding how the choice of materials affects recyclability helps to design a more sustainable product while achieving its required quality.

Further reading:
<https://urn.nsk.hr/urn:nbn:hr:216:526006>

Events

LOPEC 2025



Munich, Germany
25–27 February 2025

For the 2025 edition of this established event for flexible, organic and printed electronics, the topics of the plenary lectures include the benefits of integrating design principles with printed electronics, digital organic light-emitting diodes and displays in automotive exterior lighting, microscopic LED technology for flexible and stretchable displays, and different healthcare solutions, namely the printed electronics technology platform advancing diagnostic imaging, stretchable multifunctional platform with integrated microfluidics, photonics and electronics, and wearable devices based on hybrid printed electronics, sensors and artificial intelligence. The scientific lectures deal with power nanoelectronics, 3D kirigami lighting, organic artificial neurons, advancements in recyclable components, energy-saving production techniques and life-cycle extension strategies, printed sensors as part of a smart sensing skin for real-time monitoring of drones and planes, sensing platform for heavy metal ions monitoring, aerosol-jet printed MXene sensor arrays, high-precision capillary printing for microscale patterning of transparent conductive oxides, and more.

TAGA NextGen Conference



Boulder, Colorado USA
25–28 March 2025

The Technical Association of the Graphic Arts has become part of What-TheyThink. In 2025, the annual conference, renamed to stress the increasing focus on students as the future of the graphic arts industry, traditionally covers a wide range of topics, from examining the variation in colour gamut volume estimation and determining the optimal range of scannability and verification of 2D barcodes to developing bio-based adhesives for bookbinding applications, up to studying the impact of commercial laundering on brand colour durability on printed textiles.

10th Conference on Information and Graphic Arts Technology



CROSSING BOUNDARIES
10th Conference on Information and Graphic Arts Technology

Ljubljana, Slovenia
29–30 May 2025

The anniversary edition of this event for the graphic communications industry offers three keynotes dealing with sustainable solutions in different applications and settings. Sustainability is also dealt with in other contributions, such as the one presenting paper bags made from annual plants or those discussing the printed packaging future and packaging waste regulation. Other topics include, for example, the bibliometric analysis of typography research, properties of mixed leuco-dye thermochromic systems, and colour reproduction on 3D printed flat and low-relief surfaces.

INGEDE Symposium 2025



Munich, Germany
25–26 February 2025

The focus of this event, held in a hybrid format, is on paper recycling, especially in terms of packaging. The topics cover various aspects, including properties and combinations of materials, waste treatment, value chain redesign and developments of technologies for papermaking, printing and recycling, as well as methods for measurement and characterisation. The keynote deals with the carbon footprint of printed products.

Packaging, Labelling and Printing Events by EasyFairs



Besides several Empack events, held in UK,

Spain, The Netherlands, Portugal, and Germany from February to June 2025 and co-located with Packaging Innovations or other fairs, Paris Packaging Week is organised in France (28–29 January), Visualize Expo, formerly Sign & Print Expo, takes place in Gorinchem, The Netherlands (25–27 March), and Packaging Première and PCD are co-located in Milan, Italy (13–15 May).

FESPA Events



The series of events dedicated to speciality

printing, sign-making and visual communications can be attended around the world again in 2025. After FESPA Middle East in Dubai, UAE (20–22 January) and FESPA Brasil in São Paulo (17–20 March), three events are co-located on 6–9 May in Berlin, Germany: FESPA Global Print Expo, including the ceremony of FESPA Awards 2025, Personalisation Experience and European Sign Expo.

Screen Print Innovations 2025

Essen, Germany
3–5 June 2025



This new ESMA trade show includes the Innovation Theatre forum with keynotes presenting the latest screen-printing applications, e.g. for smart textiles, next-generation antennas and security features, sustainable screen-printing inks based on polysaccharides, and also the value of the outcome-based approach to innovations.

FLEPS 2025

IEEE International Conference on
Flexible, Printable Sensors and
Systems

Singapore
22–25 June 2025



This edition offers plenary talks by Joshua Yang on memristive devices for neuromorphic computing, Ajay Virkar on nanoscale silver for flexible and transparent electronics, and Xiaodong Chen on materials chemistry in bio-interfaced electronics, parallel lecture sessions, workshops on the Internet-of-Things kit, laser-induced graphene and flexible electronics standards, and tutorials on soft and sensor systems.

High-Performance Graphics 2025

Copenhagen, Denmark
23–25 June 2025



In 2025, this graphics and imaging systems research event is co-located with EGSR, the 36th Eurographics Symposium on Rendering.

Droplets 2025

Liège, Belgium
1–3 July 2025



The 6th International Conference on Droplets features a dozen keynotes and six plenary talks, presenting spontaneous charging of sliding water drops, droplet microfluidics, dynamics of complex interfaces, and more.

Color Impact 2025



Rochester, New York, USA
16–18 June 2025

This event is dedicated to various facets of colour research, including colour naming, using and characterising, colour-vision deficiency, and special colourants. The keynote speakers are Dimitris Mylonas, presenting research on facilitating colour communication within and across languages, Cynthia Brewer, discussing the schemes matching the perceptual dimensions of colour with conceptual structures in geographic data, and Mark Fairchild, reviewing the evolution of specifying colour and directions towards future colorimetric systems. The main programme is preceded by the pre-conference workshops, offered on 15 June; in addition, short courses are scheduled for three afternoon sessions.

NANOTECHNOLOGY 2025



Thessaloniki, Greece
5–12 July 2025

The rich programme of this event again offers five working days filled with conference sessions on nanosciences and nanotechnologies, artificial intelligence, 3D (bio)printing, intelligent manufacturing and automation, and flexible organic electronics, accompanied by the exhibition and various networking opportunities, and complemented by summer schools scheduled for the weekend days. The announced plenary talks are 'Physics approaches to organic light source enhancements' by Donal Bradley and 'MXenes and assembled 2D nanosheets redefine what materials can do' by Yury Gogotsi.

CIE 2025 Scientific Conference



Vienna, Austria
7–9 July 2025

The three-day conference is organised during the CIE Midterm Meeting, taking place on 4–11 July. The programme features, for example, the keynote on advances in artificial intelligence for the colour industry by Stephen Westland, the workshop 'Personal colour management for display devices and consumer products', and presentations dealing with the measurement accuracy in microscope-based reflectometry for thin film optical characterisation, mathematical framework for comparing photometric observers, corneal spectral sensitivities modelling, perceived white point of wide colour gamut display, validity of CIE colour matching functions for OLED-LCD mixed technology matches, broadband light source based on light-emitting diodes for radiometric calibrations in the UV region, and influence of level of details of 3D objects on realism in virtual reality.

In conjunction with the CIE event, ICC is holding a free-to-attend Expert Day on Individual Colour Matching Functions in Vienna on 8 July in the afternoon. Attendance is free, and remote participation is also possible. The announced presentations deal with individual differences of cone spectral sensitivities, possibilities to implement individual colour-matching functions in ICC.1 and ICC.2 profiles, display colour management and soft-proofing, transform the functions using a filter method, and more.