

13th International Symposium on the Science and Technology of Lighting (LIGHT SOURCES 2012)

Troy, New York, USA
24 – 29 June 2012

Editors:

**Robin Devonshire
George Zissis**

ISBN: 978-1-5108-4950-1

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2012) by Foundation for the Advancement of the Science & Technology of Light Sources (FAST-LS) All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact Foundation for the Advancement of the Science & Technology of Light Sources (FAST-LS) at the address below.

Foundation for the Advancement of the Science & Technology of Light Sources
FAST-LS
Belmayne House
99 Clarkehouse Road
Sheffield, United Kingdom
S10 2LN

www.fast-ls.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

List of Invited, Landmark and Contributed papers

Sunday Lectures

- KN01 Updating a legacy: Trading up Edison's light bulb and electrical infrastructure 3
N. Narendran
- KN02 The Impact of the Culture and Climate on Lighting Systems 9
A. Wadhwa

Session One

- KN03 CTO Session: Forecasting the Future of Lighting Technologies 21
- IL01 An overview of the non-visual effects of light: implications for new light 23
sources and lighting systems design
M. G. Figueiro
- LL01 L-Prize omnidirectional LED replacement lamp 39
A. I. Chowdhury, G. Allen, B. Chinniah, D. Cai, J. Martins, A. Rotella
- IL02 CIE myths and realities in the changing world of lighting 41
A. R. Webb

Session Two

- IL03 Development of world's first all-phosphorescent OLED product for lighting ap 45
plication
K. Furukawa, T. Tsujimura, S. Mano, A. Ezaki
- IL04 Organic light-emitting diodes using novel light emitting mechanism that 53
realizes low-cost and very high efficiency
C. Adachi, K. Goushi
- IL05 Recent developments in OLED technology for lighting applications 59
D. Bertram, H. Schwab, V. von Elsbergen, P. Loebel
- CP001 Photoluminescence studies of pure and silver Doped cadmium sulfide 61
Quantum Dots: potential candidate for fabrication of laser diodes
M. A. Gondal, M. A. Dastageer
- CP002 Technological strategy of Panasonic Lighting Business 63
K. Sato
- CP003 Hardware OLED Electrical Equivalent for Driver Topologies Design Purposes 67
D. Buso, S. Bhosle, M. Ternisien, C. Renaud, G. Zissis
- CP004 UV-C Emitting Phosphor SrAl₂O₄:Pr³⁺ for Hg-Free Xe Lamps 69
Y. Ikeda, K. Masada, Y. Kubo, H. Motomura, M. Jinno, K. Tachibana

CP005	Flux Effect of AlF ₃ on Pr ³⁺ Activated Strontium Aluminate Phosphor <i>Y. Ikeda, K. Masada, Y. Kubo, H. Motomura, M. Jinno, K. Tachibana</i>	71
CP006	New Working Amalgams for fluorescent lamps <i>A. Corazza, V. Massaro, S.P. Giorgi</i>	73
CP007	New alloy for improved mercury dosing in fluorescent lamps <i>A. Corazza, S.P. Giorgi, D. Di Giampetro, G. Santella</i>	75
CP008	Microstructural evolution in Zn-Hg amalgams used in fluorescent lamps <i>S. C. Hansen</i>	77
CP009	Self-absorption correction of fluorescence quantum yield measurement <i>C. Sciascia, A. Corazza</i>	79
CP010	Effect of the burst wave form drive on the emission characteristics of low pressure mercury lamps <i>H. Motomura, M. Jinno</i>	81
CP011	Experimental and Numerical approach to a design of highly efficient and long-lived fluorescent lamp <i>K. Miyashita, M. Kai, K. Kamio, Y. Yamagata, Y. Manabe</i>	83
CP012	Luminance enhancement of mercury-free xenon fluorescent lamps by burst pulse drive <i>H. Motomura, M. Yamada, Y. Yamamoto, M. Jinno</i>	85
CP013	254 nm Radiant Efficiency and Spectral Lines of High Output T6 Low Pressure Mercury Discharge Lamps with Neon-Argon Buffer Gases <i>H. Zhang, Q. Han, S. Zhang</i>	87
CP014	Measurement method of the glow discharge mode in instant start fluorescent lamps <i>Z. Somogyvari, P. Almosti, Zs. Buday</i>	89
CP015	Preheating Characteristics of Multiple FL Electrodes with One Heating Source <i>W. Zhang, J. Ying, R. Liang, S. Zhang</i>	91
CP016	Depletion of Mercury in Inductively Coupled Mercury-Rare Gas Discharge Plasma <i>K. Misono</i>	93
CP017	Characterization of transient processes inside an electrodeless low pressure mercury lamp driven with pulsed mode surface waves <i>C. M. Ögün, M. Bach, Ch. Kaiser, R. Kling</i>	95
CP018	Characterization of dual metal halide emission system by microwave driven mercury free low pressure lamps <i>C. M. Ögün, Ch. Kaiser, R. Kling</i>	97

CP019	An equivalent circuit model on an electrodeless fluorescent lamp with external coils <i>Y. Liu, Y. Chen, S. Yang, T. Shi, P. Pei</i>	99
LL02	Basic Research Opportunities with the Department of Energy in Solid-State-Lighting (LEDs and OLEDs) <i>E. D. Petrow, J. R. Brodrick (Oral Presentation Only)</i>	
LL03	R2R capable solution based processing of LECs <i>F.Vollkommer, J.Bauer, K.-D.Bauer, M.Müller, H.J.Bolink, D.Tordera, A.Pertegas</i>	101
IL06	Quantum-dot light-emitting diodes for applications to displays and lightings <i>C. Lee, J. Kwak, J. Lim, K. Char, S. Lee</i>	103
IL07	Optical design of enhanced light extraction efficiency in organic light emitting device with an optically controlled surface plasmon coupling <i>A. Mikami</i>	105
Session Three		
IL08	Raman scattering spectroscopy for historical incandescent lamps with a carbon filament, Hg-free HID lamps and OLEDs <i>H. Ohkawa</i>	111
IL09	Nanophosphor Materials for Lighting Applications <i>H. Menkara, A. Thamban, R. Gilstrap, M. Minkara, W. Park, C. J. Summers</i>	117
LL04	Low-mercury content Zn-Hg amalgams for fluorescent lamp applications <i>D.J. Gordon, T.I. Emilsson, S.C. Hansen, T.R. Brumleve</i>	129
LL05	C-axis Orientation and Optical Transmission Properties of Translucent Poly crystalline Alumina Ceramics <i>T. Hayakawa, S. Hayashi, S. Miyazawa, T. Ohashi, K. Watanabe</i>	131
LL06	High Efficient Metal Halide HID Systems with Acoustically Stabilized Convection <i>K. Stockwald, H. Kaestle, H. Ernst</i>	133
CP020	Studies of arc suppression in double-ended quartz halogen capsules at end of filament life <i>R.S Bergman, J. Sulcs</i>	135
CP021	Optical Emission Spectroscopy of High Efficiency Microwave Light Source <i>G.G. Lister, M. D. Bowden, N. St. J. Braithwaite</i>	137
CP022	Electrodeless Mercury Free High Intensity Discharge Lamps with high Color Rendering Indices driven by Guided Microwaves <i>Ch. Kaiser, C. M. Ögün, R. Kling</i>	139

CP023	The use of acoustic resonances to improve performance of horizontal arcs in electrodeless lamps <i>A. Hafidi, S. Mudunuri, M. DeVincentis, R. Gilliard, W. Lapatovich</i>	141
CP024	The Influence of Iodine Buffer in Indium(I) Iodide Based Electrodeless Mercury Free High Intensity Discharge Lamps Driven by Guided Microwaves <i>Ch. Kaiser, C. M. Ögün, R. Kling</i>	143
CP025	Trivit electrode design to lower quartz wall temperature in metal halide lamps <i>A. Naruka, T.R. Brumleve, M. Duda, K. Shastri</i>	145
CP026	Theoretical and experimental investigation of CMH lamps ignition properties in Ar/Hg gas mixtures <i>I. Maros, A. Andódy, S. Beleznai</i>	147
CP027	Development of Ballast-Integrated Mercury-Free Ceramic HID Lamp for Automotive Headlamps <i>M. Shido, T. Tsuda, T. Ito</i>	149
CP028	A Simple Method for the Power Balance Analysis of HID Lamps <i>V. D. Hildenbrand, A. J. Rijke, M. Gendre, M. Haverlag, G. Kroesen</i>	151
CP029	Accelerated lifetest metric for electrode damage <i>V. Zsellér, Z. Tóth</i>	153
CP030	Study on decreasing the ignition voltage of mercury-free HID lamps for automobile headlights <i>T. Uetsuki, T. Ota, Y. Onoda, T. Tsuda, M. Shido</i>	155
CP031	Experimental characterization of the warm-up of mercury lamps <i>J. Zalach, St. Franke, H. Schöpp</i>	157
CP032	Current waveform effect on the electrode tip shape of high pressure mercury lamps <i>S. Selezneva, M. Rahmane</i>	159
CP033	Time-dependent model of arc instabilities in HID lamps at high frequency <i>A. Toumi, G. Zissis, S. Bhosle, B. Baumann, M. Wolff</i>	161
CP034	Determination of atomic and excitation temperatures in a nonequilibrium HID lamp from the red wing of the 254-nm line of mercury <i>D. Karabourniotis, E. Drakakis</i>	163
CP035	Study and Design of electronic ballast for discharge lamp based on high frequency resonant inverter and current feedback control <i>B. Mrabet, M. Sarafraz</i>	165

CP036	Influence of a cold spot heating on the emitter effect of an HID lamp: Spectroscopic and pyrometric measurements <i>C. Ruhrmann, S. Gröger, T. Höbing, A. Bergner, J. Suijker, J. Mentel, P. Awakowicz</i>	167
CP037	Investigation of hot-restrikes of HID-lamps and the influence of capacitive antennas <i>T. Höbing, A. Bergner, B. Koch, F. Manders, C. Ruhrmann, S. Gröger, J. Mentel, P. Awakowicz</i>	169
CP038	Investigation of the emitter-effect of Holmium in dimmed HID-lamps <i>T. Höbing, A. Bergner, C. Ruhrmann, S. Lankes, J. Mentel, P. Awakowicz</i>	171
CP039	Minimizing the ignition voltage of automotive HID lamps by an optimized DBD ignition within the outer bulb <i>A. Bergner, T. Höbing, C. Ruhrmann, J. Mentel, P. Awakowicz</i>	173
CP040	A comparison between simulated and experimentally determined energy balances for HID lamps <i>J.F.J.Janssen, A.J.Rijke, S.Nijdam, M.Haverlag, J. Van Dijk, J.J.A.M. van der Mullen, G.M.W. Kroesen</i>	175
CP041	Mo Transport in Mercury-free Metal-halide Lamp Electrode Assemblies <i>E. G. Estupiñán, M. Quilici, W. P. Lapatovich</i>	177
LL07	End-of-Life Phenomena in Ceramic Metal Halide Lamps and Implications for Electronic Ballast Design <i>N.Brates, B.Shah, T.Sun</i>	179
LL08	Electrodeless HID Metal Halide Lamp System <i>D.A. Doughty</i>	181
LL09	Quantitative Assessment of the Energy Balances of Three Generations of Ceramic High Intensity Discharge Lamps <i>A.J.Rijke, T.L.Lemmens, J.F.J.Janssen, S.Nijdam, M.Haverlag, J.J.A.M. van der Mullen, G.M.W. Kroesen</i>	183
IL10	Microwave-powered metal halide discharge lighting systems <i>A.S. Neate, G.G. Lister</i>	185
IL11	Electrodeless Lamp Technology Overview <i>W. P. Lapatovich</i>	193
Session Four		
IL12	LED Performance and Cost Approaches Inflection Point for Consumer Lighting <i>J. Bhardwaj, O. Shchekin</i>	211
IL13	Ceramic Conversion for LED Light Sources <i>J.F.Kelso, N.Zink, M.Raukas, D.Eisert</i>	215

LL10	High-Efficiency AlGaIn-based Deep-UV LEDs Realized by Improving Injection and Light-Extraction Efficiency <i>H. Hirayama, M. Akiba, Y. Tomita, S. Fujikawa, N. Kamata</i>	227
LL11	Thermal design of integral LED replacement lamps <i>G. Allen, A. Rotella, D. Cai, J. Rintamaki, G. Kuenzler, K. Benner</i>	229
CP042	Another way to create an Auxiliary Power Supply in an LED Driver <i>B. Siessegger, C. Coleman</i>	231
CP043	System advantages of high voltage LEDs <i>B. Roberts</i>	233
CP044	An investigation of the pulse driven white LED <i>S. Yang, T. Shi, Y. Liu, Y. Chen</i>	235
CP045	Investigation of the influence of ripple current on the efficacy of GaN based white LEDs <i>T. Shi, S. Yang, Y. Liu, Y. Chen</i>	237
CP046	High Efficient and Cost Effective Passive Cooling Design for SSL <i>Y. Cheng, Z. Zhou, X. Lin, Y. Mao, N. Linder</i>	239
CP047	SSL Convection in thermally adverse conditions <i>T. Dreeben</i>	241
CP048	Tube Element LED with Active Convection System <i>C. Zhenliu, J. Jiaqi, G. Shihong, C. Zonglie, C. Dah</i>	243
CP049	Development of the Bar Type COB LED Module for applying of LED Luminaire <i>H. J. Jang, S. M. Lee, J. C. Lee</i>	245
CP050	Modulation Scheme for Dimming High-Brightness LED Lamps <i>C. Brañas, F.J. Azcondo, R. Casanueva</i>	247
CP051	Optical Characterization of Non-Radiative Recombination Centers in InGaAs/AlGaAs Quantum Wells by Below-Gap Excitation <i>A. Z. M. Touhidul Islam, K. Hatta, N. Murakoshi, T. Fukuda, T. Takada, T. Itatani, N. Kamata</i>	249
CP052	Development of LED lamp having a widespread light distribution of 300 degrees <i>Y. Hosoda, M. Kai, Y. Manabe, K. Takahashi, S. Shida</i>	251
CP053	Development of Nostalgic Clear-type LED <i>M. Akai, T. Mori, N. Tagami, M. Horiuchi</i>	253

CP054	Optimal white LED package with high uniformity in angular CCT distribution <i>C-Y. Chen, C-C. Chen, C-Y. Chiu, Y-N. Peng, Y-H. Wang, T-H. Yang, T-Y. Chung, C-Y. Chung, C-C. Sun</i>	255
CP055	Measurement Uncertainty Analysis for Dominant Wavelength of LEDs <i>H. Shen, X. Zhou, W. Zhang, M. Liu</i>	257
CP056	Simulation tool for optimizing LED phosphor compositions <i>I. P. Bakk, G. Borsoi</i>	259
CP057	A series of flat shaped LED light engines with a heat-transfer solution <i>T. Yasuda, J. Sasaki, Y. Takahara, S. Oosawa</i>	261
LL12	Wafer level white LED packaging technology for extremely low cost and compact solid state lighting devices <i>M. Shimada, A. Kojima, Y. Akimoto, H. Tomizawa, H. Furuyama, S. Obata, K. Higuchi, Y. Sugizaki, H. Shibata</i>	263
LL13	Rare earth-free direct-emitting light emitting diodes for solid state lighting <i>C. Wetzel, T. Detchprohm</i>	265
IL14	High-power LEDs for solid-state lighting: reliability issues and degradation modes <i>M. Meneghini, G. Meneghesso, N. Trivellin, E. Zanoni</i>	267
IL15	LED Packaging and Reliability for Lighting Applications <i>S. Liu, K. Wang, Z. Chen, X. Luo</i>	271
Session Five		
IL16	Near Infrared Pulsating Converging Beam Device for Photodynamic Therapy of Brain Tumors <i>H. Whelan, E. Rietema</i>	289
IL17	UV Light Independently Suppresses Autoimmunity and Initiates the Vitamin D Endocrine System <i>H.F. DeLuca</i>	297
IL18	Factors determining the spectral sensitivity of neurobehavioural and neurophysiological responses to light <i>R. Lucas, T. Brown, A. Allen, J. el Enazi, V. Revell</i>	299
CP058	Vapor Pressure Enhancement of Rare-Earth Metal-Halides <i>J. J. Curry, E. G. Estupiñán, W. P. Lapatovich, A. Henins, J. Gibbs, S. D. Shastri, and J. Hardis</i>	303
CP059	Thermodynamic data for the (NaI-CeI3) system in the condensed & gas phases <i>A.T. Dinsdale, R.H. Davies, S.A. Mucklejohn</i>	305

CP060	Thermodynamic data for the (CsI-CeI ₃) system in the condensed & gas phases <i>A.T. Dinsdale, R.H. Davies, S.A. Mucklejohn</i>	307
CP061	Molecular constants and standard enthalpies of formation for the lanthanide monohalide gaseous cations, LnX ^{+<g>} , X = F, Cl, Br, I <i>S.A. Mucklejohn</i>	309
CP062	Comparison of CQS(Qg) and Optimal Color Volume for the evaluation of Color Saturation <i>J. M. Quintero, C. E. Hunt, J. Carreras</i>	311
IL19	Metrics for color Quality of Light Sources <i>Y. Ohno</i>	313
IL20	A Look inside the Regulatory Environment <i>J. G. Howley Jr.</i>	317
IL21	Educating Stakeholders on Metrics Used in Lighting Regulations <i>P. Horner</i>	319
IL22	New benefit metrics for more valuable lighting <i>M. S. Rea</i>	321
LL14	Basic Spectroscopic Data on the First Spectra of Rare Earths: Recent Results for Er I, Gd I, and Nd I and Work in Progress on Sm I and La I <i>J. E. Lawler, E. A. Den Hartog, J. P. Chisholm, J.-F. Wyart, K. A. Bilty, A. J. Fittante, M. H. Stockett, M. P. Wood</i>	323
LL15	Methodology study of life cycle assessment of light sources <i>L. Tähkämö, G. Zissis, C. Martinsons</i>	325
Session Six		
IL23	Organic Light Emission: Control and manipulation of excitons to achieve bright OLEDs and organic lasers <i>S. Forrest, Y. Zhang</i>	329
IL24	Novel Semipolar InGaN Based Light Emitting Diodes for High Current Density Applications <i>S. P. DenBaars, Y. Zhao, C. Pan, S. Tanaka, D. Feezell, J.S. Speck, S. Nakamura</i>	331
IL25	Thermal Analysis and Management of Optoelectronic Devices <i>M-Whan. Shin</i>	335
LL16	A color classification for light sources used in general illumination <i>J.P. Freyssinier MS, Rea</i>	337
LL17	Design of Light Emitting Diode Clusters for Optimal Museum Lighting <i>A. Rachel, R. Henderson, B. Roy, S. Berns</i>	339

LL18	A study on the appearance of paintings under near ultraviolet and blue LED <i>N. Yoshizawa, T. Fujiwara</i>	341
LL19	Lighting Engine for Art and Museum Display <i>P. Vitta, A. Tuzikas, A. Žukauskas, R. Vaicekauskas, A. Petrulis, M. S. Shur</i>	343
Session Seven		
IL26	The LED technology for dynamic lighting <i>J-M. Hwang, C-W. Lin, W-L. Yu, Y-T. Huang</i>	347
IL27	Impact of LED driver architecture on luminaire design <i>R. Jacobs</i>	349
IL28	GaN on 8” Silicon LEDs for Low-Cost LED Manufacturing <i>S. Lester</i>	351
IL29	Diffuse Area Light Sources for General Illumination — A Technology Survey and Comparison <i>M-H. Lu, J. Fisher, P. Ngai</i>	353
IL30	Remote Phosphor Applications For The LED Lighting Markets <i>M. Jansen, J. Carey, N. Deeman, C. Edwards, H-C. Lee, D. O’Hare, Y-Q. Li, H. Yang</i>	355
CP063	Effect of CCT on discomfort glare for LED road lighting <i>X. Zhu, S. Deng, M. Zhang, W.Cheng, W. Li, I. Heynderickx</i>	357
CP064	Study on flicker perception as a consequence of low-height LED luminaires used for road lighting <i>W. Li, W. Cheng, X. Zhu, I. Heynderickx</i>	359
CP065	Light flickering effects on visual perception <i>L. Arexis Boisson, G. Zissis, S. Kitsinelis</i>	361
CP066	Method for recording and identifying the flicker of commercial lamps and different technologies <i>S. Kitsinelis, G. Zissis</i>	363
CP067	The influence of the change of correlated color temperature and illuminance in daytime on the task performance and circadian rhythm <i>N. Toda, H. Noguchi, A. Yasukouchi, Q. Nan</i>	365
CP068	Evaluation of AC-LED Lighting Flicker on Visual Fatigue and Comfort <i>P. H. Hsieh, E. C. Chang, Y. C. Chen</i>	367
CP069	Factorial Effect Analysis of the Visual Characteristics of a White-LED Composed of Four Primary Colors <i>K. Misono</i>	369

CP070	Spectra Preference Measurement: An Evaluation of Software Industry Desirability Assessment Techniques for Lighting Applications <i>J. Spaulding</i>	371
CP071	Evaluation of discomfort against bright lights by measuring hemoglobin concentration in frontal lobes <i>H. Motomura, N. Nishiguchi, M. Jinno</i>	373
LL20	Visual performance and perceived lighting quality under flickering illumination <i>J. D. Bullough, N. P. Skinner, K. Sweater Hickcox</i>	375
LL21	Pulse Modulation Effect of LED on Human Perception Enhancement <i>Guxin, W. Gao, M. Liu</i>	377
LL22	High color mixing collimating luminaire by RGB LEDs <i>X-H. Lee, Y-C. Lo, B-C. Chiu, W-T. Chien, I. Moreno, C-C. Sun</i>	379
Session Eight		
IL31	Light Emitting Diodes as Photosynthetic Radiation Sources <i>K. Peiler, R. Swamy</i>	383
LL23	LEDs on the Go: Supporting Pedestrian Flows in Public Transit Networks with Accent Lighting for Increased Efficiencies and Ambient Information Display <i>S. Seitinger, M. Canazei, H. Schrom-Feiert</i>	389
LL24	User Experience Design and Gesture Control for Color Tunable LED Lighting <i>J. Spaulding, J. Holt</i>	391
LL25	Laser-Driven Light Sources as Calibrated Spectral Irradiance Standard <i>H. Zhu, J. Hammond, G. Hill, M. Besen, D. Smith, P. Blackborow</i>	393
LL26	High-Quality, Energy-Efficient and Affordable Light Source using Cathodoluminescent Phosphors <i>C. E. Hunt, S. C. Blackstone</i>	395
LL27	New Approach for Tunnel Illumination Method of High Luminance Uniformity using LEDs <i>M. Kimura, S. Hirakawa, H. Uchino, H. Motomura, M. Jinno</i>	397
CP072	A Study of Flat Electron-Excited-Phosphor Dark-discharge Luminescent Lamp <i>Y. Zhang, S. Kitsinelis, G. Zissis, M.C. Liu, J.Y. Li, S.P. Chen</i>	399
CP073	High temperature thermal radiation from mesoscopic selective emitter <i>T. Matsumoto, Y. Kawakami, S. Omori, M. Tomita</i>	401
CP074	Ultrahigh Brightness and Broadband Laser-Driven Light Source <i>H. Zhu, G. Hill, M. Besen, D. Smith, P. Blackborow</i>	403

CP075	Study on the Characteristics of Coaxial KrBr Excilamps <i>Q. Han, X. Zhuang, S. Zhang</i>	405
CP076	Polarization effect and spectral changes in electroluminescent lamps <i>W. Kaiser, A.F. Correa, R. P. Marques</i>	407
CP077	High Efficiency Fluorescent Excimer Lamps <i>N. Masoud, D. Murnick</i>	409
CP078	Biological actions of light on fish. How to create a proper experimental illumination design? <i>St. Franke, A. Brüning, H. Schöpp, F. Hölker, W. Kloas</i>	411
CP079	Large area illumination system for solar cell array <i>J. Liu, H. Li, R. Wu, J. Yu, B. Jiang</i>	413
CP080	The Pulse Rate Measuring System which Use FBG Sensors <i>Y. Miyauchi, H. Ishizawa, S. Koyama</i>	415
CP081	Optical simulations of light guides based on manufactured micro-structures # <i>Q. Huang, J. Olsen, Y. Yang, C. Ghiu, M. Li</i>	417
CP082	Design of an anti-glare projection lamp based on a double-reflector <i>J-Y. Cai, Y-C. Lo, C-C. Tsai, X-H. Lee, W-T. Chien, C-C. Sun</i>	419
CP083	“Day for Night” - An evaluation of LED advertisement screen’s effect on occupant’s behavior <i>K. Talebian, S. K. Kahouei, Y. Mohamadi</i>	421
CP084	Development of UV water treatment system using cold cathode lamps with small diameter <i>H. Motomura, R. Higa, H. Murakami, M. Jinno, K. Tachibana, K. Yanai, T. Matsumoto, H. Yano, K. Yuasa</i>	423
IL32	Biologically Efficient Light Sources in Application Studies <i>A. Wojtysiak, H. Helbig, D. Lang</i>	425