



7<sup>th</sup> INTERNATIONAL TEXTILE CLOTHING & DESIGN CONFERENCE  
October 5<sup>th</sup> to October 8<sup>th</sup>, 2014, Dubrovnik, CROATIA

# Magic World of Textiles

## BOOK OF PROCEEDINGS

Organized by:  
**University of Zagreb**  
**Faculty of Textile Technology**  
**Zagreb, CROATIA**



Under the auspices of:



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The proceedings of the International Textile Clothing and Design Conference have been indexed in the Conference Proceedings Citation Index- Science (CPCI-S), while a selection of the papers from the 7th ITC&DC 2014 will be published in the following publications: AATCC Review (ISSN 0040-490X), Journal of Natural Fibres (1544-046X – electronic; 1544-0478 - paper), International Journal of Clothing Science and Technology (ISSN 0955-6222), International Journal of Simulation Modelling (ISSN 1726-4529), Kemija u industriji (ISSN 0022-9830) and Tekstil (ISSN 0492-5882).

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## PREFACE

Dear colleagues, dear friends!

The Faculty of Textile Technology, University of Zagreb, has organised the 7<sup>th</sup> International Textile, Clothing and Design Conference – Magic World of Textiles in Dubrovnik, which makes this conference, now we can be sure and proud of it, a traditional one.

Of the papers received this year, the members of the International Reviewer Committee have accepted 116 papers for the 7<sup>th</sup> ITC&DC and all of them are published in this Book of Proceedings. It witnesses to the fact we are all sure of – that the scientific research in the field of textiles is attractive, interesting, and a “cool” field.

Our big ITC&DC family has grown out of the seven ITC&DC conferences organised up to now, and it includes more than 2150 authors from 36 countries of Europe and all over the world. As every decent family, we have found, thanks to the hospitality of the Centre for Advanced Academic Studies (CAAS), our home here in Dubrovnik.

I am sure everybody is eagerly looking forwards to meeting the old friends here in Dubrovnik, or just to see who would come and get some new acquaintances. I am personally grateful to all the colleagues who attended previous ITC&DC for coming again to the beautiful town of Dubrovnik. However, I am sincerely happy for those who are here in Dubrovnik and Croatia for the first time. Welcome home, all of you! Dubrovnik is the city everybody falls in love with. Once you have seen it, you return.

For a number of important reasons, the ITC&DC is organised in Dubrovnik. Historically speaking, at the time of the Dubrovnik Republic (from the early Middle Ages to the time of the Napoleonic Wars) the ships of the Republic sailed world-wide, and Dubrovnik even had its colonies (not many people know that Goya in India used to be a Dubrovnik colony). The part of the town called Pile, where our Conference is held, used to be the centre of textiles in the Dubrovnik Republic, and the peasants in the nearby Konavosko polje reared silkworms and produced silk until the mid-nineteenth century. Dubrovnik is also a city of exceptional cultural and historical monuments and is included in the UNESCO World Heritage List. It is also a city with a millennium (or almost two millennia) history, where everybody can find his/her true self. *Those who seek paradise on Earth should come to Dubrovnik and see Dubrovnik*, as Bernard Shaw once said. This is why we are in Dubrovnik.

I would like to express my sincerest thanks to all the participants for their valuable contribution and readiness to spend a part of their time in Dubrovnik, making the picture of the Magic World of Textiles more valuable and more real.

My special thanks go to the Government of the Republic of Croatia, as well as to the international scientific associations that have accepted to be the patrons of the conference, proving it to be necessary, justified and useful.

My gratitude also goes to all the individuals and institutions that have helped organising the 7<sup>th</sup> ITC&DC.

Zvonko DRAGČEVIĆ

## Final report for ITC&DC Conferences – Magic World of Textiles

### 1<sup>st</sup> ITC&DC 2002

<i>Date &amp; Place</i>	October 6-9 <sup>th</sup> 2002, Dubrovnik, Croatia
<i>Under the Auspices</i>	DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; The Textile Institute, Manchester, United Kingdom; The International Textile Academy New Delhi, India; University of Zagreb, Zagreb, Croatia; Croatian Academy of Engineering, Zagreb, Croatia
<i>Scientific Committee</i>	Ivo Soljačić (HR) – president; D. C. Adolphe (FR), A.P. Cavaco (PT), Z. Dragčević (HR), J. Geršak (SI), B. C. Goswami (US), P. K. Hari (IN), B. Katalinić (AT), D. Katović (HR); P. Kiekens (BE), I. Krucinska (PL), J. Kurz (DE); A. Marcincin (SK), J. Militky (CZ), P. Offermann (DE), K. Slater (CA); Z. Sukang (CN), N. Starszakowna (GB), G. Stylios (GB), C. Q. Yang (US).
<i>Plenary lecture</i>	Branko KATALINIĆ: Technical Product as Materilisation of Engineers Idea and Design Strategy of Nature
<i>Publication</i>	Book of Proceedings of the International Textile, Clothing & Design Conference, ISBN 953-96408-8-1
<i>Editor</i>	Zvonko Dragčević
<i>ISBN</i>	953-96408-8-1
<i>Publisher</i>	University of Zagreb, Faculty of Textile Technology, Zagreb, Croatia
<i>Authors / Papers</i>	239 / 129
<i>Number of Countries Participants came from</i>	26
<i>Referred /Indexed in</i>	Conference Proceedings Citation Index – Science (CPCI-S), World Textile Abstracts, Textile Technology Digest, Textile Global/Net, Chemical Abstracts
<i>Selected Papers published in Journals after Conference</i>	International Journal of Clothing Science and Technology, <b>15</b> (2003) 3/4, (ISSN 0955-6222)
<i>Organising Committee</i>	Z. Dragčević – president, N. Vuljanić – vice president, D. Grundler, A. Hursa, N. Krmpotić, T. Rolich, D. Rogale, E. Vujasinović

### 2<sup>nd</sup> ITC&DC 2004

<i>Date &amp; Place</i>	October 3-6 <sup>th</sup> 2004, Dubrovnik, Croatia
<i>Under the Auspices</i>	Ministry of Science, Education and Sport, Zagreb, Croatia; University of Zagreb, Zagreb, Croatia; Ministry of Economy, Labour and Entrepreneurship, Zagreb, Croatia; Croatian Chamber of Economy, Zagreb, Croatia; DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; The Textile Institute, Manchester, United Kingdom; The International Textile Academy New Delhi, India; Croatian Academy of Engineering, Zagreb, Croatia; Croatian Society of Chemical Engineers, Zagreb, Croatia
<i>Scientific Committee</i>	Ivo Soljačić (HR) – president; D. C. Adolphe (FR), M. Akalin (TR), M. Duarte de Araujo (PT), S. K. Batra (US), X. Ding (CN), Z. Dragčević (HR), J. Geršak (SI), B. C. Goswami (US), P. K. Hari (IN), H. Harms (AT), B. Katalinić (AT), I. Krucinska (PL), J. Kurz (DE); A. Marcincin (SK), H.J. Mencer (HR), J. Militky (CZ), D. Rogale (HR), E. Schellmeyer (DE), N. Starszakowna (GB), G. Stylios (GB), T. Takagishi (JP), C. Q. Yang (US).

<i>Plenary lecture</i>	George K. STYLIOS: New Measurement Technologies for Textiles and Clothing
<i>Publication</i>	Book of Proceedings of the 2 <sup>nd</sup> International Textile, Clothing & Design Conference, ISBN 953-7105-05-9
<i>Editor</i>	Zvonko Dragčević
<i>Publisher</i>	University of Zagreb, Faculty of Textile Technology, Zagreb, Croatia
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<i>Authors / Papers</i>	352 / 180
<i>Number of Countries Participants came from</i>	29
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<i>Selected Papers published in Journals after Conference</i>	International Journal of Clothing Science and Technology, <b>17</b> (2005) 3/4, (ISSN -955-6222)
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### **3<sup>rd</sup> ITC&DC 2006**

<i>Date &amp; Place</i>	October 8-11 <sup>th</sup> 2006, Dubrovnik, Croatia
<i>Under the Auspices</i>	Ministry of Science, Education and Sport, Zagreb, Croatia; University of Zagreb, Zagreb, Croatia; Ministry of Economy, Labour and Entrepreneurship, Zagreb, Croatia; Croatian Academy of Engineering, Zagreb, Croatia; DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; The Textile Institute, Manchester, United Kingdom; The International Textile Academy New Delhi, India; American Association of Textile Chemists and Colorists, Research Triangle Park, United States of America; Croatian Society of Chemical Engineers, Zagreb, Croatia; International Federation of Knitting Technologists, Reutlingen, Germany; Croatian Chamber of Economy, Zagreb, Croatia; INA Oil Industry, Zagreb, Croatia; City of Dubrovnik, Croatia
<i>Scientific Committee</i>	Ivo Soljačić (HR) – president; D. C. Adolphe (FR), M. Akalin (TR), M. Duarte de Araujo (PT), S. K. Batra (US), K. Dimitrovski (SI), Z. Dragčević (HR), J. Geršak (SI), B. C. Goswami (US), P. K. Hari (IN), A. R. Horrocks (GB), B. Katalinić (AT), I. Krucinska (PL), S. Kukle (LV), A. Marcincin (SK), H. J. Mencer (HR), J. Militky (CZ), R. Postle (AU), D. Rogale (HR), E. Schollmeyer (DE), H. Shosenji (JP), N. Starszakowna (GB), G. Stylios (GB), X. Tao (CN), R. Wardman (GB), C. Q. Yang (US).
<i>Plenary lecture</i>	Eckhard SCHOLLMAYER: Nanotechnology for Functionalization of Textile Materials
<i>Publication</i>	Book of Proceedings of the 3 <sup>rd</sup> International Textile, Clothing & Design Conference, ISBN 953-7105-12-1
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<i>Authors / Papers</i>	414 / 183
<i>Number of Countries Participants came from</i>	31

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<i>Selected Papers published in Journals after Conference</i>	International Journal of Clothing Science and Technology, <b>19</b> (2007) 3/4, (ISSN 0955-6222), Kemija u industriji, <b>56</b> (2007) 11, (ISSN 0022-9830), Tekstil <b>56</b> (2007) 2, (ISSN 0492-5882)
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**4<sup>th</sup> ITC&DC 2008**

<i>Date &amp; Place</i>	October 5-8 <sup>th</sup> 2008, Dubrovnik, Croatia
<i>Under the Auspices</i>	Ministry of Science, Education and Sport, Zagreb, Croatia; University of Zagreb, Zagreb, Croatia; Croatian Chamber of Economy, Zagreb, Croatia; Croatian Academy of Engineering, Zagreb, Croatia; DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; The Textile Institute, Manchester, United Kingdom; The International Textile Academy New Delhi, India; Society of Dyers and Colourists, Bradford, United Kingdom; Croatian Society of Chemical Engineers, Zagreb, Croatia; INA Oil Industry, Zagreb, Croatia
<i>Scientific Committee</i>	Ivo Soljačić (HR) – president; D. C. Adolphe (FR), M. Akalin (TR), M. Duarte de Araujo (PT), A. Curteza (RO), K. Dimitrovski (SI), Z. Dragčević (HR), J. Geršak (SI), B. Katalinić (AT), I. Krucinska (PL), S. Kukle (LV), A.V. Kulichenko (RU), A. Marcincin (SK), H. Mattila (FI), J. Militky (CZ), R. Postle (AU), H. Rödel (DE), E. Schollmeyer (DE), N. Starszakowna (GB), G. Stylios (GB), X. Tao (CN), D. Ujević (HR), L. Wadsworth (US), C. Q. Yang (US).
<i>Plenary lecture</i>	Charles Q. YANG: New Development in Functional Finishing and Cotton Textiles
<i>Publication</i>	Book of Proceedings of the 4 <sup>th</sup> International Textile, Clothing & Design Conference, ISBN 978-953-7105-26-6
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**5<sup>th</sup> ITC&DC 2010**

<i>Date &amp; Place</i>	October 3-6 <sup>th</sup> 2010, Dubrovnik, Croatia
<i>Under the Auspices</i>	President of the Republic of Croatia Prof. Ivo Josipović, Ph.D.; Ministry of Science, Education and Sport, Zagreb, Croatia; University of Zagreb, Zagreb, Croatia; Croatian Chamber of Economy, Zagreb, Croatia; Croatian Academy of Engineering, Zagreb, Croatia; DAAAM International, Vienna, Austria; AUTEX, Ghent, Belgium; Croatian Society



	of Chemical Engineers, Zagreb, Croatia; American Association of Textile Chemists and Colorists, Research Triangle Park, United States of America; International Federation of Knitting Technologists, Reutlingen, Germany; ESCORENA Poznan, Poland; CARNet, Zagreb, Croatia
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<i>Plenary lecture</i>	Dubravko ROGALE: Research and Development of Article of Clothing with Adaptive Mikroklimatic States
<i>Publication</i>	Book of Proceedings of the 5 <sup>th</sup> International Textile, Clothing & Design Conference, ISSN 1847-7275 [Book proc. (Int. text. cloth. des. conf.)]
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## 6<sup>th</sup> ITC&DC 2012

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<i>Plenary lecture</i>	Ron POSTLE: Mechanics and Physics of Soft Matter: Knitted Fabrics

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<i>Organising Committee</i>	Z. Dragčević – president, N. Vuljanić – vice president, M. Bobovčan Marčelić, A. Hursa Šajatović, Z. Kovačević, I. Matijević, B. Mauser, B. Šaravanja, E. Vujasinović



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