

COORDINATING TECHNICAL COMMITTEE ANNUAL REPORT 2016

CTC CHAIR



E-mail: inoue@iis.u-tokyo.ac.jp

CTC MEMBERS



**J. Parker
(Secretary)**



B. Hehlen



J. Jones



K. Richardson



**H. Sesigur
(Invited)**



X. Zhao

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1. Executive Summary

CTC Actions in 2016

A CTC brain storming workshop was held on 19th February, 2016 in Madrid, Spain. A business meeting took place in Shanghai, China on 9th April, 2016, during the 24th International Congress on Glasses. In addition to these meetings, telephone conferences among CTC members were organized bimonthly.

The meetings focused on a summary of activities, presented by the cluster coordinators. The Steering Committee decided to provide financial support to stimulate the development of new actions in the TCs. Special events, such as expert workshops and schools, were organized. The CTC followed and evaluated the development of such events.

The CTC followed the activity of TCs and took care of the necessary adaptations of the TC structure. It was decided that two new TCs should be created.

Cooperative actions of the technical committees

The main actions performed by TCs are Round Robin tests and organization of conferences and symposia. A complete description of these cooperative action is given in the following sections.

ICG Schools

The 2nd Winter School took place 31st March – 5th April, 2016 at Wuhan University in China, just before the ICG Congress in Shanghai, China. Ten topics were covered by lecturers from the Montpellier Summer School core team and 8 topics were presented by Chinese colleagues. A total of 33 students participated, 30 were from different locations in China, 1 from Japan, 1 from India and 1 from Sudan.

The 8th workshop for new researchers in Glass Science and Technology ran on 4-8th July, 2016 in Montpellier, France. Altogether 36 participants from 10 countries attended, 28 of whom signed up for a Glass Science stream and 8 for Glass Technology. Three of these students on the day adopted a mix-and-match approach. On the first day everyone attended the same introductory courses and the seven project groupings had participants from both streams mixed together. Most lecturers gave two one hour presentations and their contribution, freely given, is greatly appreciated.

The morning of the last day was the opportunity for the students to demonstrate their lecturing skills and to present their conclusions on the set projects. The final judging proved tight, and eventually two first prizes were awarded, one to the group examining mechanisms of sodium ion diffusion and the involvement of non-bridging oxygens (Helene Pablo, Luka Pavic, Celine Ragoen, Alessio Zandona, Abdul Rashidi), and the second to a group tasked with creating a project for a final year undergraduate student on glass melting (Vickie Falk Jensen, Miroslava Huyjova, So Sakurai, Damier Bolore, Frederik Van Hoof, Ana Aznar). Third place went to the big EGO company based on an Environmental Glass Organisation, set up to win a large international prize by solving a major social issue (Thorben Welter, Laura Aalta-Setala, Julian Moriceau, Ben Allsopp, Philippe Kiefer).

Books

Using a grant from the ICG CTC committee, Technical Committee TC04 have created a new Open Access e-Book "Inorganic Biomaterials" co-edited by Prof W. Hoeland and Prof A. Boccaccini, which was published in the Frontiers collection. This can accessed using the link: http://www.frontiersin.org/books/Inorganic_Biomaterials/836.

A New DVD covers ceramics failure and safe design. Steve Freiman explores the practical fracture mechanics background necessary to understand brittle failure, and describes some of the unique characteristics of ceramic materials that must be taken into account in their design and use. The course also will review best practices in the use of both fracture mechanics and strength tests, the

powerful tool of quantitative fractographic analysis in understanding the cause of failure, and a modern, computer-driven approach to statistically examine strength distributions for ceramics and set service stresses to ensure safe lifetimes to very low probabilities of failure. The course is on two DVDs, each well over 1 hour, and costs \$295 for non-members of ACerS.

[The 24th International Congress on Glasses](#)

From 7-11th April the Shanghai International Convention Centre in Shanghai, China became the opulent venue for the 24th International Congress on Glasses. The Congress was hosted by the Chinese Ceramic Society working with the International Commission on Glass. The Congress Chairman was Prof. Shou Peng of China Triumph International Engineering Co., the former president of ICG, Chair of the Scientific Committee was Prof. Jianrong Qiu and Chair of the Organising Committee was Mr. Zhanping Jin. The opening ceremony began with welcomes from the ICG president, Dr. Manoj Choudhary, president of the Chinese Ceramic Society, Dr. Yongmo Xu, a representative of the Municipal Government and finally Prof. Shou Peng. Next followed an Awards Ceremony. First were the prestigious President's Awards given to: Dr. N. F. Borrelli (USA), Prof. A. Makashima (JP), Prof. J. Parker (UK) and Prof. Shou Peng (CN). Secondly the Turner Prize was awarded to: Prof. A. Boccaccini (TC03) and Dr. S. Slade (TC13). Prof. R. Martin (UK) was the recipient of the Gottardi Prize and he later gave a plenary presentation entitled 'A structural insight into bioactive glass'. The Weyl award was presented to Dr. Qiang Fu (USA) who subsequently spoke on 'Glasses for healthcare: research, development and industrialization'.

Altogether, 803 people registered for the Congress of whom 169 were students. The 270 international participants represented 33 countries. During the conference copies of the latest book to be authored by Prof. Fuxi Gan and Prof. J. Henderson were made available.

Each session was preceded by at least one Plenary Lecture. An unusual session examined good teaching practice and was aimed at young lecturers. Another highlight was the congress banquet, held on the penultimate evening. It took place in the Sea Palace Floating Restaurant, a large moored barge not far up the river from the congress centre and with wonderful views of the Bund.

The Stevanato Group provided invaluable support by sponsoring the poster competition. Altogether 104 posters were offered and covered a wide range of subjects. Prizes were given to: T. Nakaya (Nagaoka University of Technology, Japan), W. Chung (Kongju National University, Korea) and W.C. Peng (South China University of Technology, Guangzhou, China). The Chinese Ceramic Society also generously sponsored 5 prizes in the oral sessions for the best young speakers: T. M. Dubernet (the University of Rennes, France), C. Ragoen (the University of Brussels, Belgium), W. Chung (the Kognju National University, Korea), S. Cozic (the University of Rennes, France and Yamagata University, Japan), and M. Xi (Wuhan University of Technology, China).

The Poster and Young Speaker prizes were distributed during the closing ceremony and were followed by a formal handover to the American Ceramic Society who will organise the 25th Congress in Boston, where we were promised a warm welcome.

[Turner Award](#)

The Turner Award was given jointly to Prof Aldo Boccaccini (DE) and Dr Simon Slade (UK).

Prof. Boccaccini is a member of TC04 and a major contributor to their work.

Sadly Dr Slade could not be present. He is a very good and engaged secretary of TC13 Environment since 2001. He was later presented with his award at a special event in the UK.

ICG fund for 2017

CTC offered the financial support of total amount of 1400 Euro. The member of CTC evaluated the applications from TCs which was applied by using the fixed application form. The maximum amount of the support was 3500 Euro to each TC. The chosen TCs and the amount of support are shown in the table. A report of the use was required in annual report 2017.

Table. Results of the amount of the support

	Technical Committee	Amount of Support (Ero)
TC03	Glass structure	2000
TC04	Bioglass	2800
TC07	Crystallisation & GCs	2500
TC13	Environment	1600
TC16	Nanostructures	2700
TC27	Atomistic Simulation	2300

Annual Report changes

CTC asked TC chairs to place their annual reports directly onto the ICG web site. This will help to ensure that the web site will be an up-to-date summary and review of overall ICG activities.

Plans for 2017

The Annual Meeting on ICG will be held in Istanbul, Turkey on 22-25th October 2017.

A large number of technical committees will meet in the Annual Meeting in Istanbul.

CTC Business Meeting planned in Istanbul, Turkey, on 24th October 2017.

The International Conference on Advances in Glass Science and Technology (ICAGST-2017) on 23th-25st January and a 3 day student tutorial session take place on 19th-21st January in Kolkata, India.

The annual Montpellier Student Workshop will be held on July, 2017 and the two parallel sessions, with some lectures in common one on "Glass formation, structure and properties" and the other on "Numerical Simulation of both glass structure and processing".

The 3rd ICG Winter School will be held in Wuhan, China, from 13th-17th November 2017.

2 Summary of R&D Activity Fields & TC Activities

2.1 BASIC GLASS SCIENCE – Coordinator: B Hehlen

TC03 - Glass Structure - met twice in 2016, in Shanghai during the "International Congress on Glass" (ICG), and in Sheffield during the European Symposium on Glass (ESG).

In Shanghai, they discussed the future activities of the TC03: The chair of the TC (D. Neuville) showed the program of a school/workshop about the nature of the network former. A long discussion followed this presentation; the program of the school workshop needed to be modified. Daniel Neuville, Doris Moncke, Fran Munoz, Akira Takeda, Akira Saito were present at the meeting.

The second meeting of the TC members in Sheffield concerned the possibility to organize a thermodynamic school about the glass and melts. After discussion, TC members decided to organize a school on glass thermodynamic before or after the DGG-USTV annual meeting 2019 in Erlangen. This school should be organized by Prof D. de Ligny and Dr Natalia Vedishcheva. Daniel Neuville, Efstratios

Kamitsos, Akira Takada, Natalia Vedishcheva, Ondrej Gedeon, Marek Liska, Doris Moncke, Alex Hannon, Jana Holubova were present at the meeting.

The main action for 2017 is the organisation of a school/workshop entitled: structural role of elements in glasses, from classical concepts to a reflexion over broad composition range. The school will be held in Cargese, March 27-31, 2017. Several people from TC03 are involved in the organisation and as lecturers. The event will be partially supported by CTC grant.

A second planned action will be a meeting in Oxford in July 2017 during the borophosphate conference.

TC07 - Crystallisation & GCs - aims to publish joint research activities in print media. The list below shows upcoming and finalized special issues on crystallization in glasses and glass-ceramics (guest editors in brackets):

- Nucleation and Crystallization of Glasses and Glass-Ceramics, *Frontiers in Materials*, 2017 (W. Höland, J. Deubener);
- Glass-ceramics, *Materials Research Bulletin*, 2017 (M.J. Davis, E.D. Zanotto)
- *Journal of Non-Crystalline Solids*, Volume **384**, 2014 (J. Deubener)
- *Journal of Non-Crystalline Solids*, Volume **356**, Issues **52-54**, 2010 (V.R. Mastelaro, M.J. Davis, E.D. Zanotto)
- *Am. Ceram. Soc.*, CD-ROM 2009, ISBN 978-0-470-09732-8 (M.J. Davis)
- *Phys. Chem. Glasses* **45**, 2004 and *Glass Technol.* **45**, 2004 (P.F. James)
- *Glotech. Ber. Glass Sci. Technol.* **73 C1**, 2000 (W. Höland)
- *Journal of Non-Crystalline Solids*, Volume **219**, 1997 (E.D. Zanotto)

Other activities in 2016

- TC07 represented by their members M.J. Davis and E.D. Zanotto organized the Session 2 "Fundamentals and applications of glass-crystallization" at the GOMD meeting in Madison, USA in 2016.
- Lectures were given at the 8th ICG Summer School in Montpellier in cooperation with TC23 and others on crystallization issues.
- TC07 provided open access to a wide range of research facilities, material resources and unpublished data for their members, especially young professionals (industry) and PhD students (academia) of the member's groups.

Plan for 2017

- To organise the 12th International Symposium on Crystallization in Glasses and Liquids in Segovia, Spain (September 10-13).
- To publish research results in media jointly. An e-book of the S.D. Stookey issue on controlled crystallization of glasses will be published by *Frontiers in Materials* in Spring 2017. Also a special issue on glass-ceramics in the *Materials Research Bulletin* for March 2017 is approved.
- To continue in training young researchers. Contributions at the 9th ICG Summer School are planned. The open laboratories policy turned out to be one of the best measures to attract young researchers to the field of crystallization and glass-ceramics and to share experience among TC07 members.

- To maintain collaboration with other TCs on structural issues (TC03), mechanical properties (TC06) and the biological response (TC04) of glass-ceramic materials.

TC26 - Structure & Vibrations - met once in Shanghai during the International Congress on Glass (ICG). The aim of the meeting was to open a discussion to reorient the scientific objectives of TC26 toward theoretical tools likely to provide a better understanding of the acoustic and optic vibrations in glasses.

Plan for 2017 is to reorganise TC26 according the above consideration. A call for new members will be made. The TC will centre its activity on emerging statistical and modeling tools that help describing the optic and acoustic vibrations in glasses.

TC27 - Atomistic Simulation - met during the International Congress on Glass (ICG) in Shanghai, April 2016.



- During the Congress they presented a poster introducing TC27 to the glass community.
- TC27 Chair and committee members co-organized four sessions on modeling and simulations of glasses during the ACerS GOMD meeting in Madison Wisconsin May 2016:

Co-Chaired by Jincheng Du, Carlo Massobrio, and Walter Kob, five focused sessions were organized on glass simulations during GOMD.

Session 1: Potential development and MD simulations of multicomponent glasses.

Session 2: Modeling of glasses under extreme conditions

Session 3: Predicting glass properties from simulations

Session 4: First principles methods and ab initio MD simulations of glasses

Session 5: Simulations of chalcogenide and metallic glasses

- TC member Liping Huang co-organized the first Computational Design of Ceramic Materials Symposium at MS&T conference in Salt Lake City UT in October 2016.
- Continuation work on a book project on fundamentals of glass simulations with Wiley.

Plan for 2017

- Next TC meeting of TC27 is planned during the PACRIM and ACerS GOMD meeting in Hawaii May 2017. A meeting is also planned for the ICG annual conference 2017 in Yokohama, Japan.
- Work on the book project with Wiley on glass simulations and publish by the end of the year.

- Organize the 3rd challenge workshop atomistic simulations of glasses in San Carlos, Brazil. This Workshop will be co-sponsored by ICG and University of São Carlos in July 2017.

2.2 GLASS PRODUCTION – Coordinator: Hande Sesigur

There are seven technical committees (TCs) in the Glass Production cluster. All these committees continued their activities according to the needs of the glass industry in which the Coordinating Technical Committee decided to organize the studies of each TC.

The main objective of TC09 is to identify the major process steps, with potential for energy efficiency improvement e.g. glass melting, glass conditioning, raw material supply & recycling, post-processing of glass; to select technologies with potential for efficiency improvement; to test or develop tools to that support energy efficiency investigations (e.g. energy balance models for glass furnaces, protocols for energy management, energy audit procedures dedicated to glass production plants, LCA modeling); to define research activities for developing energy saving glass production methods; to organise symposia or sessions on energy efficiency in glass production at ICG annual meetings and congresses; to share energy consumption and CO₂ emission data (anonymous) for benchmarking purposes; and to share practical experiences and problems related to new energy saving technologies (e.g. use of batch preheating, flue gas heat recovery systems, energy efficient furnace designs, recycling etc.).

The most important aim for 2016 is to define a uniform approach to define energy efficiency or specific energy use within or across the various glass industry sectors. With the financial support of ICG, TC09 started a project to realize this goal. Firstly, TC09 will be focussing on glass melting furnaces, the largest energy consumers of a glass factory. The results of this project will be used to explain the energy balances of glass furnaces and to evaluate the methodology of applied energy balance models, measuring techniques and benchmark data.

In 2016 energy benchmark project has been done for 6 float furnace with the aim to agree a uniform approach to define energy efficiency or specific energy use within or across the various glass industry sectors. A draft publication is in progress. In order to evaluate these benchmark results, it is needed to calculate the minimum thermodynamic batch melting energy. Several batches were defined and the minimum melting energy was calculated by using a model of thermodynamics.

Technical committee working on refractory materials and its interaction with the glass melt, TC11, met once in 2016 at Dusseldorf. Their main aim is to discuss the material related problems in glass melting furnaces and the defects generated by these materials like blisters, stones, knots and cords. So TC11 tries to find out solutions and experimental testing methods by exchanging the knowledge and experiences between the members and participants from refractory industry, glass industry and academia. New and improved materials for new solutions of refractory material problems of glass furnaces including refractory materials exposed to molten glass and batch, combustion gases and flue gases (regenerator), are the most important topics of interest for TC11.

In 2016, the chairman of TC11 was changed and Rongxing Bei from RHI Refractories, was elected as the new chairman. The committee discussed advanced refractory materials and worldwide industrial experience on glass melting furnaces were shared. The material properties and application problems are reported and analyzed. For the future studies, TC11 aims to prepare and recommend testing procedure and inspection methods for refractory materials.

The environmental committee, TC13 covers all environmental issues affecting the glass industry. TC13 tries to achieve best practice by exchange of information concerning current and developing techniques for reducing the environmental impact of glass during its production, use and disposal.

This shall include the comparison of the results of different control techniques and the determination of best practice for measuring pollutants (primarily total particulate, NO_x, SO_x, HCl, HF & heavy metals) by means of parallel measurements, material balances, and round robin tests.

The TC meets twice a year, in those meetings they discussed about the updates on the operation of Cercat ceramic catalytic bag house, and the measurement of emissions of boron, selenium, and ammonia. Another important topic was the respirable fraction of glass-making sand. The other important topic of interest was EP dust and how to assess the impact of increased recycling of cullet and EP dust on the accumulation of unwanted components in the furnace system. High cullet use and EP dust recycling are good environmental practices, but may be associated with an increase in halides and heavy metals in the glass and in the emissions. Finally, the committee considered the presence of respirable crystalline silica in various glass-making sands.

TC14, working on gasses in glass, promotes activities to better understand evolution mechanisms of gases in glass and bubble formations. It supports cooperation with other Technical Committees in order to fulfill its mission. Most of its recent activities have been carried out jointly with TC11 and TC18 regarding the influences of glass contact materials and melting process on bubble formation.

The annual meeting of TC14 was held on 5th of September, 2016 at the SGT Centenary Conference & ESG2016 in Sheffield, UK. The results obtained for both static and dynamic Round Robin Tests on refractory bubbles which is proposed as a joint work of TC14 - TC11, were not satisfied. These joint work will be rediscussed based on the decision of TC11. The other topic in the current agenda was to prepare a web page of TC14. The recent info page of TC14 activities was created into the ICG page structure. Besides the annual meeting of TC14, a joint meeting of TC11-TC18 was held on the same day. They discussed ongoing topic, "Bubble Nucleation Temperature".

TC18, working on Glass Melting, promotes the activities in the field of both fundamental and application research concerning stages in the glass melting process. It supports co-operation among technical committees involved in the cluster Glass Production. *Their main current project is on Nucleation of Bubbles in Glass Melt.* The aim of the project is to understand the mechanism and kinetics of bubble nucleation, to restrict bubble defects and to study the effect of bubble nucleation process on melting improvement. First step of the project which involves the Round Robin Test on the determination of the nucleation temperature was completed and the final results were evaluated. *The second project that TC18 works on is Batch Melting Kinetics.* The goal of the project is to develop a standard test to evaluate melting kinetics of glass forming raw material batches. In the initial stage of the project, the suitable experimental procedure was discussed and the experimental setup was proposed. The project will be associated with the proposed project of the TC14 focused on the analysis of bubbles nucleated on dissolving sand grains. Current experimental methods for the "Determination of Batch Free Time" were presented and discussed during the committee meeting. In 2017 the committee will launch a Round Robin Test on the Determination of Batch Free Time.

The committee of Melting Modelling, TC21, focuses on improving the quality and reliability of glass furnace simulation models and optimizing the software packages of different suppliers via describing heat transfer, flows and temperatures in glass furnaces (melt, batch & combustion space). However the most effective way to understand the strong and weak points is by simulating with the different participants the same well defined existing glass melting furnace and ideally with actual measured and validated data. This allows the member of this committee to compare and validate results with each other and also with real measured data.

On 4 September 2016 the Technical committee met in Sheffield UK. Aaron Huber from Johns Manville, was introduced as the new chairman of the committee. The committee invited Glass Futures to their

meeting and tried to collaborate in a study of modelling a 30 tonnes/day furnace and compare the results with the focus on batch models. This study will allow to compare different modeling approaches and the actual batch shape obtained with the Glass Futures furnace, which is one of the weakest points of furnace modelling. This and other topics will be discussed at the next committee meetings. The other activity of the committee was updating the info page of TC21.

The committee on modelling of forming, TC25, focuses on furthering knowledge pertaining to glass forming process by providing a medium for interaction between researchers and practitioners. In 2016, the committee was inactive. TC25 will regroup in 2016 and will work on “gob in delivery system” as well as preparing a guideline document on numerical simulation of glass forming processes.

2.3 CHARACTERISATION – Coordinator: Julian Jones

TC02 - Durability and Analysis - development of standard methods of analysis and the production of certified reference materials (CRMs) for analytical calibration supported by round robin/proficiency testing schemes. In 2016 TC02 carried out proficiency tests on hydrolytic resistance testing of glass containers according to ISO 4802-1; a Round Robin test of trace analysis of sand (collaboration with German Society of Glass Technology DGG) and completed viscosity proficiency testing work to support glass wool manufacture (with St Gobain). There are currently beginning tests to certify new CRMs and are validating application ICP for arsenic determination.

TC06 – Mechanical and nanomechanical properties - Merged from TC06 and old TC08 (Relaxation phenomena in glasses) in 2015, launching a new TC at the Sheffield SGT100 meeting in September 2016, where they also organized a round table discussion on “Ultrastrong Glasses”. A transcript of the discussion will be published in the first half of 2017. A special edition of *Frontiers in Materials* was put together on Glass Science. Focus for the next 5 year is development of stronger, tougher glass through topography and thermal processing and identifying mechanical testing protocols at the macro/micro and nanoscale.

TC10 - Optical measurement techniques. The work of TC10 is a pre-normative reference for European standards committees and work has contributed to the development and revision of glass in buildings standards such as EN 410, EN 673, EN 12898 and ISO 9050. Recent work addressed the spectrophotometric determination of emissivity, error sources in the measurement of diffuse optical properties and the accuracy of portable instrumentation for the determination of color parameters. Current activities include the development of measurement procedures for reliable measurement of the transmittance of three dimensional patterned glass, fritted glass and laminates and determination of dispersion functions for bare glass substrates.

2.4 APPLICATIONS – Coordinator: Kathleen Richardson

The APPLICATION CLUSTER is comprised of six (6) technical committees, including TC04 (biomedical), TC05 (nuclear and hazardous waste), TC12 (pharmaceutical packaging), TC16 (nanostructured glass), TC20 (optoelectronics) and TC24 (coatings). During 2016 TC24, has come under new leadership and now is active again thanks to invigoration by its new TC Chair. A short summary of key accomplishments and current membership numbers (in parentheses), are included here with additional details found on the ICG website.

TC04 (28 members including 7 new young scientist members) continues to be an active contributor to ICG especially in their proliferation of journal articles, books and focus issues in magazines and other periodicals. Highlights for 2016 beyond these exemplary publications are numerous commemorative articles/symposia and a planned biography to the late Larry Hench who passed this past year. The TC has met numerous times this past year, participated in a diverse range of international meetings, carried out round robin testing on bio-activity (9 institutions, 7 countries) and has focused extensively

on marketing and integration with young/younger scientists and highlighting international partnerships, exchanges and funding realized by TC members. Their addition of new members, specifically younger scientists is noted.

TC05 (23) continues their ongoing activities disseminating information at numerous global meetings. The TC has hosted numerous sessions and workshops associated with these meetings, bringing together TC members to sponsor technical programming at major glass and ceramic conferences. Long-time TC chair Jim Marra turned over the chairmanship to Olivier Pinet, passing along momentum in continuing efforts in scientific round-robin studies (Liquidus study, T_L), published proceedings from workshop and other activities. Efforts going forward are to continue activities to update and promote TC sponsored activities and publications.

TC12 (15), continued activities (meetings and studies/experimental trials by members) in a round robin activity to set up an experimental protocol for the evaluation of delamination propensity in glass vials. This work, an ongoing focus of the TC was discussed at multiple meetings within 2016 and a revised strategy for 2016 and 2017 was defined with the aim to optimize the procedures and propose a reliable method. These activities by members are ongoing. It is planned that the findings from this study will be reported on in a scientific paper on the experience of TC12 to the PDA Journal of Pharmaceutical Science and Technology.

TC16 (11) committee members remain active in collaborative activities related to joint research projects in both melt-derived and sol-gel based materials doped with rare earth and other ions. Efforts have focused on relating form and composition to crystallization stability and optical properties. The TC continues the development of nanostructured, transparent doped oxy-fluoride glass-ceramics by melt-quenching, for optical communications, lasers and displays, as well as nanostructured sol-gel coatings doped with sensitizer/acceptor lanthanide pairs for frequency conversion in photovoltaic solar cells, in order to increase their efficiency. Solar-control coatings which can reflect the sun light will be investigated, based on ZnO:Al or ZnO:Ga.

TC20 (21) members were heavily involved in the celebrations of the International Year of Light (IYL), that extended from the official opening ceremony in Paris on January 19-20, 2015, until the closing ceremony in Mexico, on 4-6 February 2016. IYL 2015 saw over 13,000 events take place with an impact that reached 147 countries; the final report may be downloaded from <http://www.light2015.org/dam/About/IYL2015-Final-Report/IYL2015-Final-Report.pdf>. As part of these activities, TC members were Guest Editors of a Special Issue on "Light, Energy and Life" of Journal of Luminescence, which appeared as Volume 170, Part 3 (2016). Authors of the published articles included several TC20 members. PRE'16, the "flagship" workshop of the TC was held in Greenville, South Carolina (USA) on 8 - 10 June, 2016. Additionally the TC met at the CerSJ-GOMD Joint Symposium on Glass Science and Technologies, Kyoto, Japan in November with 156 papers and broad attendance by ICG leadership. TC member continue their broad, multi-society activities and have received numerous international awards during the period.

TC24 (15) was re-activated in 2016 due to the appointment of the new TC chair, Joop van Deelen. Under new leadership, the TC has made as a focus the to initiate specific focus on two technical areas, specifically in failure mechanisms of TCOs in devices and standardizing testing methodologies and performance criterion for AR (anti-reflection) coatings.

2.5 INFORMATION, EDUCATION, HISTORY – Coordinator: John Parker

The Communications, History and Education Cluster remains active; major discussions within ICG have centred around the issue of Communications during the last year and the effectiveness of what is achieved, while the success of TC23 has spawned new activities. Two of the chairs of TCs in this cluster

reached the end of their standard 3+3+3 year terms in 2016 and have continued as acting chairs since. Discussions on ensuring continuity have taken place and will be finalised at the next CTC meeting in Turkey (2017).

The Communications TC (TC01) reports to both the Steering Committee on publication matters and on communication as well as carrying out a variety of tasks for CTC. Its small but active membership includes the chair, Dr Bange and also the ICG Vice-president, Prof Duran. The appointment of Gabriele Peron, Stevanato, to the Steering Committee has in effect added an extra active member to this committee and 2 or 3 other individuals are being sort, particularly from the younger community. Regular contact is maintained using e-mail and Skype. A major effort continues to be press releases: 25 have been added to the ICG web site, a 20% increase on the previous year. Several of these news items have also been published more widely in various glass magazines. The major revision to the structure of the ICG web site mentioned in the last report is allowing evolutionary change to the web site; there remain just a few issues to be resolved with the web providers but we are now looking at the possibility of making more use of the web site, links to Social Media, Webinars etc. For the first time TC chairs have been strongly encouraged to update their own web sites, and to use them to present their annual reports. This has been largely achieved with relatively few issues arising and the chair of TC01 is very grateful for the assistance given by other TC chairs. At the same time the database which underpins the TC membership lists has been extensively updated using information provided directly by TC chairs. More TCs are also making use of the document storage facilities that the web pages provide.

TC17 has been re-grouping and continued this process during 2015 with the goal of increasing activity. It has been planning a session for the next Congress in Shanghai, China in April 2016 and a number of abstracts have been submitted. Towards the end of 2014 the committee successfully applied to the CTC for funding for a textbook on ancient sites for bead making in India. This project has proceeded smoothly and the text is now with the Printers. Publication is expected early in 2016.

TC23 met during the ICG conference in Shanghai. Specific major activities during the last year have included the running of Schools for new Research Workers and the successful 2014 1st Winter School in China (2014) was followed by a 2nd Winter School in 2016 preceding the Shanghai Congress. The Annual Montpellier Summer School was held in July (the 8th) and the committee has begun to look ahead to a special celebration at the 10th Summer School in 2018. Following the recommendations of the ICG Management Board TC23, has been exploring the possibility of expanding ICG TC23 activities. As a result they assisted in the planning of a special Tutorial Session during the conference in Kolkata India in January 2017. In 2012, the German Museum in Munich presented a series of books covering the basics of glass science and technology at the level of an undergraduate introductory course. The texts are presented in German and English. The opportunity of expanding this series is still under consideration. ICG funds have also been received to encourage student participation in ICG conferences. They were offered to students to attend Shanghai and the ESG conference in Sheffield. Further funding will be allocation for students to attend the next ICG conference in Istanbul in Oct 2017.

3. Organizational issues

The present situation for CTC officers and TC chairs is summarized in the Table below:

Decisions on the following persons/functions were prepared:

H. Inoue took over as CTC Chair at the meeting in Shanghai.

The position of H. Inoue on CTC was taken by B. Hehlen.

H. Sesigur was made an acting member of CTC for the next year.

R. Conradt has completed 9 years as chair of TC23. He will continue as acting chair for 1 more year and during this time seeks a replacement and a new secretary.

J. Parker has also completed a second term of 9 years as chair of TC01 and secretary of the CTC.

R. Almeida has also completed 9 years as Chair of TC16. He is willing to continue as acting chair for the next year and during this time will look for replacement.

R. Eiden became the new chair of TC02 (Durability & Analysis) replacing D Michiels.

J. van Deelen was appointed the new chair of TC24 (Coating on Glass).

The creation of a new TC (Fiber Reinforcement, TC28) was approved (Chair Y Yue, Vice-Chair H Li).

S. Kim was appointed the new chair of TC19 (Glass Surfaces).

4. Reports of the activities of individual TCs

This year TC chairs have been asked to submit their reports directly to the ICG web site so that they are more accessible to the wider public and also available in a more timely fashion. Thanks to the efforts of the TC chairs this process has been completed and the reader is therefore referred to: www.icglass.org.