

## COORDINATING TECHNICAL COMMITTEE ANNUAL REPORT 2017

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# 1. Executive Summary

A business meeting took place on 22<sup>nd</sup> October, 2017 in Istanbul, Turkey, during the annual ICG meeting. In addition to this meeting, telephone conferences amongst the 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 outcome 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 one TC (TC25 on the Modelling of Forming) should be closed.

## 1.1 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 actions is given in the following sections. The Summer and Winter Schools are written up as press releases for advertising purposes. Abridged versions of these press releases are presented below.

## 1.2 ICG Schools & Workshops

Montpellier Summer School, 3-7th July 2017

The 9th workshop for new researchers in Glass Science and Technologies ran on 3-7th July, 2017 in Montpellier, France. Altogether 49 participants, 37 from academia and 12 from glass manufacturers, took part, the largest number ever. The School timetable consisted of 18 formal one hour lectures either on a pure science theme (Glass formation, structure and properties) or on mathematical modelling (How numerical modelling can respond to the technological challenges in glasses). All the students were together on the first day and then split into two groups for the remainder of the event.

On the first afternoon each student was expected to introduce their research interests to the rest of the group. The formal activities of the first day concluded with a detailed presentation from Dr. Manoj Choudhary of Owens Corning and also current ICG President. He spoke on the proper treatment of heat transfer by radiation in a partially absorbing medium and how this influences processing of glass.

Tuesday followed the same pattern except as two separate streams from 11 am to lunch time. After lunch came the allocation of projects, 8 in total with 6 students in each group. They were given their tasks. These exercises were open ended with the goal that the group should give a 15 minute presentation at the end of the week, where they analysed the key issues involved and how they might be investigated.

On Friday morning the school concluded with presentations from the students on their project outcomes. After a 25 minute deliberation by the judges, first, second and third places were awarded. The winning project titles were respectively: 1) Given the environmental problems caused by polymer microbeads in shampoos would glass microbeads be a better choice? 2) Some glass beads ancient (3400 years old) recently discovered in graves in Denmark were alleged to have come from Egypt. How would you confirm this? 3) There is currently considerable interest in glasses made under extreme conditions (experimentally and computationally). What glass system would you like to investigate, how would you attempt this and what properties of the resulting glass would you investigate?

We acknowledge with thanks this year's lecturers who give of their time freely and often stay in the same student accommodation as the delegates to keep costs low. This year 16 individuals contributed to the school at no charge: K. Bange, M. Choudhary, R. Conradt, L. Cormier, P. Florian, E. Gouillart, R. Hand, A. Habraken, B. Hehlen, A. Karadag, H. Mahrenholtz, F. Maurer, H. Mueller-Simon, J. Parker, M. Pascual, A. Takada. Of these R. Conradt, B. Hehlen, J. Parker, A. Takada and M. Hubert were responsible for the overall planning and publicity for the two themes of the event. We would also like to acknowledge the hard work of Mylene Boscus, the course administrator, and Bernard Hehlen who is the local contact point for all academic matters. We received many positive comments at the end of the course from the participants. For example one wrote 'By the end of the week, I can clearly say that we have gained great knowledge not only from the lectures but also from the group project' adding 'To be honest, it overtook my expectations'. Watch this space ([www.icglass.org/education/](http://www.icglass.org/education/)) for further information.

### 3rd ICG Winter School in Wuhan

On 12th November 2017, 35 research and masters students met at the Vienna International Hotel in Wuhan for a one week Winter School on 'Glass Formation, Structure and Properties'. Prof. Chao Liu in the Wuhan University of Technology led the local organisation with assistance from Prof. Jihong Zhang and Prof. Kai Xu, and several local doctoral students who had attended previous winter schools. Six of the teachers from the Montpellier Summer School (Professors Conradt, Hand, Hehlen, Parker, Takada and Vacher) provided teaching on fundamentals of glass technology such as thermodynamics, durability, diffusion, structure and its analysis. They were joined by several local lecturers who spoke on NMR (Prof. Jinjun Ren), X-ray absorption spectroscopy (Prof. Yong Gyu Choi, South Korea), glass ceramics (Prof. Jian Yuan) and ion implantation to make biosensors (Prof. Taras Kavetsky, Russia).

The formal talks filled the morning sessions from Monday to Thursday - four lectures a day each of 45 minutes with the goal of teaching current understanding of fundamentals. The first afternoon provided an opportunity for the students themselves to tell everyone their individual areas of interest. Each gave a 5 minute presentation based on their research topics. The remaining afternoons were filled with project work. Students were grouped in fives based on their backgrounds and given open-ended projects to investigate, matched as far as possible to their interests. On the last morning they were expected to present together a 15 minute talk summarising their conclusions on their allocated topics.

After a relatively short deliberation the winning team of: Ang Qiao, Wuhan University of Technology; Malwina Stepniewska, Aalborg University, Denmark; Xinxin Chen, Beijing University of Technology; San Yeol Shin, Korea Aerospace University; Shisheng Lin, Wuhan University of Technology was announced. Their project was to decide whether the environmentally damaging plastic microspheres in various cosmetics could be successfully replaced by glass products the same topic that came first in Montpellier.

### 1.3 Activities of other TCs

There were several other schools and workshops organized by TCs.

TC03: School/workshop: structural role of elements in glasses, from classical concepts to a reflexion over broad composition range, Cargese, 27-31<sup>st</sup> March 2017.

TC05: The Joint IAEA-ICTP Workshop on fundamentals of glass transition and vitrification technologies 6-10<sup>th</sup> November 2017 in Trieste-Miramare, Italy. The proceedings of the workshop are available on the ICTP web-site: <http://indico.ictp.it/event/8002/>

TC07: The “12<sup>th</sup> International Symposium on Crystallization in Glasses and Liquids” 10-13<sup>th</sup> September 2017 in Segovia, Spain.

**TC20: PRE'17**, the Seventh International Workshop on **Photoluminescence in Rare Earths: Photonic Materials and Devices**, 29<sup>th</sup> November - 2<sup>nd</sup> December 2017 in Rome, Italy.

**TC27: The 3<sup>rd</sup> Challenge Workshop on MD simulations of Glass and Amorphous Materials**, 9-12 July, 2017 in São Carlos, Brazil.

## 1.4 Publications

TC04 and member of TC04 published the following items:

- 1) Delia Brauer and Jamieson Christie reviewed “The role of fluoride in the nanoheterogeneity of bioactive glasses” in *Phys. Chem. Glasses*, **58**, 180 (2017).
- 2) A double special issue to honour the great Prof. Larry Hench has now been published by *J. Mater. Sci.* Many of the TC04 members contributed to this special issue as authors and Aldo R Boccaccini, JRJ, Len Rahaman and Enrica Verne are guest editors.
- 3) Julian Jones, Leena Hupa, Delia Brauer and David Greenspan contributed a review on Bioactive glass products in a special issue of *International Journal of Applied Glass Science* called “The Glass Age”.
- 4) The "Bioactive Glasses: Fundamentals, Technology and Applications" book edited by Aldo R. Boccaccini, Delia S. Brauer and Leena Hupa and published by the Royal Soc. of Chemistry is now available.

TC07 members published jointly their research activities. The list below shows upcoming and finalized special issues on crystallisation in glasses and glass-ceramics (guest editors are indicated in brackets).

- 1) Selected paper of the Segovia Meeting will be published in *J. Non-Cryst. Solids* in 2018 (submission closed on Dec. 01, 2017)
- 2) "Nucleation and Crystallization of Glasses and Glass-Ceramics" *Frontiers Media SA*, 2017 (W. Höland, J. Deubener)
- 3) *MRS Bulletin*, Volume 42, Issue 3, 2017 (M.J. Davis, E.D. Zanotto)

TC16 published the following items:

- 1) Tiago V. Ribeiro, Luís F. Santos, M. Clara Gonçalves, Rui M. Almeida, “Heavily Yb-doped silicate glass thick films”, *J. Sol-Gel Sci. Technol.*, **81** (2017) 105–113. DOI: 10.1007/s10971-016-4071-7.
- 2) E.L. Payrer, A.L. Joudrier, P. Aschehoug, R.M. Almeida and J.L. Deschanvres, “Up-conversion luminescence in Er/Yb-doped YF<sub>3</sub> thin films deposited by LI-MOCVD”, *J. Luminescence*, **187** (2017) 247 – 254. DOI: 10.1016/j.jlumin.2017.02.051.
- 3) João Ferreira, Luis F. Santos, Rui M. Almeida, "Sol-gel derived Yb:YAG polycrystalline ceramics for laser applications", *J. Sol-Gel Sci. Technol.*, **83** (2017) 436–446. DOI: 10.1007/s10971-017-4420-1.
- 4) Rui M. Almeida, Tiago Ribeiro, Luís F. Santos, “Sol-gel derived active material for Yb thin-disk lasers”, *Materials* **10**, 1020 (14 pp.). DOI: 10.3390/ma10091020.

TC20 published the following:

- 1) G. C. Righini, S. Jiang and F. Prudenzeno were Guest Editors of a Special Issue of the journal *Fibers* entitled "Advances in Optical Fibers II". The issue included, among others, an important review paper authored by some TC20 members (J. Ballato, H. Ebendorff-Heidepriem, J. Zhao, L. Petit, J. Troles, Glass and process development for the next generation of optical fibers: a review, *Fibers* **5**, 11 (2017); doi:10.3390/fib5010011).

- 2) J. Ballato was Guest Editor, with D. Milanese and F. Sorin, of a Special Issue of Optical Materials Express entitled "Advanced Multimaterial and Multifunctional Optical Fibers".
- 3) J. Ballato and L. Jacobson were Guest Editors of a Special Issue of Optical Materials entitled "Photoluminescence in Rare Earths 2016: Photonic Materials and Devices".
- 4) G. C. Righini completed the editing of a book on "Glass Micro- and Nanospheres: Physics and Applications", which will be published by Pan Stanford in 2018. TC20 members were collaborating.

TC27 are working on the following book project:

- 1) Working with Wiley on "Computer Simulations of Glasses: Methodologies and Applications" co-edited by Jincheng Du and Alastair Cormack.

TC28 published the following:

- 1) Qun Zu and Qian Zhao (ed.) High Performance Glass Fiber (in Chinese), National Defense Industry Press (China) 2017.

## 1.5 The Annual ICG Conference 2017

The 2017 Annual ICG Conference took place in Istanbul, Turkey from 22-25<sup>th</sup> October in parallel with the 32nd Şişecam Glass Symposium and with the support of GlassTrend. The Vice Chairman and CEO of Şişecam, Prof. Dr. Ahmet Kirman was the conference chair and was supported by a team of Şişecam employees. This was the second time that ICG had met in Turkey and the chosen venue, the Haliç Conference Centre had excellent hotels within walking distance. While the local political situation may have deterred some potential attendees, nevertheless a total of 421 participants, representing 26 different countries, turned the event into a great success. 380 were from Europe, 29 from Asia and 8 from America.

The opening ceremony always provides the opportunity to reward particularly meritorious achievements. This year the Gottardi prize winner was Ashutosh Goel of Rutgers University, USA, while the Turner award went to Prof René Vacher (France). The conference had 29 sessions with up to 5 in parallel; several were based on novel themes. Altogether there were 6 plenary lectures, 24 invited speakers, 94 oral presentations and 18 posters. Two highlights were a Workshop on Ion Exchange and a special session organised by Prof. Alicia Duran to commemorate eminent glass scientist, Prof. Bill Prindle. A third successful feature was to encourage participation by a younger audience with a relaxed mentoring session arranged on the last morning of the event. A speed dating approach paired older and younger generations, offering those embarking on their careers personal insights into the experiences of the 'old-timers'.

The conference banquet took place at the CVK Bosphorus Hotel near the home of the famous Beşiktaş football club. At the closing ceremony talks by Profs David Pye and Manoj Choudhary argued the case for naming the current era as 'the Glass Age', given the central role of glass in modern civilisation. The closing ceremony included awards for the two best posters. First was Lukas Pavic, a PhD student from the Ruđer Bošković Institute, Zagreb, Croatia who won the Stevanto Group prize and second was Gulio Giorni, from the Institute of Glass and Ceramics in Spain, who received the award sponsored by Şişecam.

During the conference, the Council, Steering Committee and Coordinating Technical Committee all met. Important decisions were taken on the venues for the 2020 and 2021 Annual Meetings. We will all meet again in 2020 in Krakow, Poland and in 2021 will go for the first time to South Korea. At the close of the ceremony the responsibility for organising the 2018 event in Yokohama was formally handed over to our Japanese colleagues.

## 1.6 Turner Award

The Turner Award was given to Prof. Rene Vacher, Professor of Montpellier University. He was a member of the Coordinating of Technical Committee from 1999 to 2016, being its vice chair from 2005 to 2009 and Chair from 2010 to 2016. He organized the 2002 ICG Annual Meeting in Montpellier on behalf of the Institute du Verre and became leader of the Project Management team for the European Union EFONGA grant for 1.6 million Euro along with Fabio Nicoletti and Klaus Bange who were joint applicants. This project ran for 4 years.

## 1.7 The Best TC Websites

The best TC websites as judged by the CTC were TC04: Bioglasses, TC07: Crystallisation & GCs, and TC20: Optoelectronics. The proposed prize consisted of a 700 Euro (max) contribution to a dinner for the winning TC members. Since this year's funding was limited, the prize was given only to TC04.

## 1.8 ICG fund for 2017

CTC offered financial support up to 7000 Euro to its TCs. The members of the CTC evaluated the applications from five TCs which were selected using an agreed procedure. The maximum amount of the support was 3500 Euro to each TC. The chosen TCs and the actual amounts of support are shown in the table. A report of the use made of the funding was required for the annual report. The committees not receiving support were encouraged to resubmit at a later date.

Results of the amount of the support

Technical Committee			Amount of Support (Euro)
TC02	Durability & Analysis	Workshop on standardisation of chemical durability measurements	2500
TC05	Waste Vitrification	Monograph of talks from recent meeting in Spain	2500
TC07	Crystallisation & GCs	Generating videos/webinars	0
TC18	Glass melting	Postage etc. Costs of distributing batch for RR tests	1600
TC20	Optoelectronics	Publication of conference proceedings (Open Access)	0

## 1.9 Annual Reports

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

## 1.10 Plans for 2018

The Annual Meeting on ICG will be held in Yokohama, Japan on 23-26<sup>th</sup> September 2018.

Many technical committees will meet in the Annual Meeting in Yokohama.

A CTC Business Meeting is planned in Yokohama, Japan, on 24<sup>th</sup> September 2018.

The 10<sup>th</sup> Montpellier Student Workshop will be held on 2nd to 7th July, 2018 and have two parallel sessions, with some lectures in common, one on "Glass formation, structure and properties" and the other on "Bioglasses".

The 4<sup>rd</sup> ICG Winter School will be held in Wuhan, China, from 4<sup>th</sup>-10<sup>th</sup> November 2018.



## 2 Summary of R&D Activity Fields & TC Activities

### 2.1 BASIC GLASS SCIENCE – Coordinator: B Hehlen

The activity of the cluster «Basic Glass Science» in 2017 mostly relates to TC meetings at conferences, to the chair of sessions at conferences, and to the organization of conferences and workshops. The activity also involved publishing jointly research activities in journals and books.

#### TC meetings at conferences

- TC03 meet in Oxford, UK July 26, 2017 during the “borophosphate” conference.
- TC07 had a business meeting in Segovia, Spain Setp.2017 during the 12<sup>th</sup> symposium on Crystallisation in Glasses and liquids.
- TC27 meet in Sao Carlos, Brazil July0217 during the workshop on MD simulation of glass and amorphous Materials.

#### Organization and chair of symposiums or sessions at conferences

- TC27 Co-chaired the Glass and Optical Material Symposium during MS&T 2017 in Pittsburg, USA.
- TC27 Organized the 3<sup>d</sup> Challenge Workshop on MD simulations of Glass & Amorphous Materials in Sao Carlos. The workshop was jointly funded by ICG CTC fund and funds from local host at *Federal University of São Carlos*.
- TC26 Co-organized the session “glass under extreme conditions” at GOMD 2017 in Hawaii, USA.

#### Organization of conferences, schools, and workshops

- TC03: *School workshop in Cargese (France- March 27-31-2017) « structural role of elements in glasses, from classical concepts to a reflexion over broad composition range Cargese ».*
- This school/workshop welcomed more than 70 people from Spain, England, Germany, Canada, Denmark, Italy, and France for a week. This week was shared in theoretical presentations that had been chosen by TC03-GDR-USTV and a round table discussion on the concept of network former for all glass families: oxides, chalcogenides, metals. The event was cu-funded by the ICG.
- TC07: *12th International Symposium on Crystallization in Glasses and Liquids (Crystallization 2017).*
- The conference held in the historic city of Segovia, Spain and was chaired by M.J. Pascual and A. Durán. The Spanish Society of Ceramics and Glass (SECV) had the pleasure and honour to host this conference, which is the twelfth in a series. Over the years, these bi- or triennial meetings have established a strong international reputation for disseminating the state-of-the-art in crystallization research, from fundamental aspects to innovative glass-ceramic products. The Segovia meeting covered the areas of simulation and theory, formation, structure, properties, and applications of crystallized glasses presented in 57 lectures (including 11 invited talks) and 76 posters.
- TC26: *9th Montpellier summer school on glass science and technology*
- The ICG summer school on glass held in Montpellier from the 3<sup>rd</sup> to the 8<sup>th</sup> of July 2017. About 35 PhD students, young researchers, and engineers, originating from about eight countries attended the school co-chaired by B. Hehlen. This year, the focus was given on “how numerical modelling can respond the technological challenges in glasses”.

#### Other activities

- Members of TC03, TC07, TC26, and TC27 contributed with invited talks to international conferences.
- TC07 provided access to a wide range of research facilities, material resources and unpublished data for their members.

- TC07 published a jointly research activity in a print media: "Nucleation and Crystallization of Glasses and Glass-Ceramics" Frontiers Media SA, 2017 (W. Höland, J. Deubener) MRS Bulletin, Volume 42, Issue 3, 2017 (M.J. Davis, E.D. Zanotto).
- TC27 planned a special issue on "Molecular Dynamics Simulations of Glasses: Current Status and Challenges" at *Journal of Non-Crystalline Solids* that will be published in 2018.
- TC27 is still working on a book project with Wiley on "Computer Simulations of Glasses: Methodologies and Applications" co-edited by Jincheng Du and Alastair Cormack.

## 2.2 GLASS PRODUCTION – Coordinator: Hande Sesigur

There are six technical committees (TC) in the Glass Production cluster. All these committees continued their activities according to the needs of the glass industry with the coordination of the "Coordinating Technical Committee" of ICG.

**TC09:** Technical Committee on Energy Efficiency TC09, mainly focus on glass melting since this contributes on average about 60-65 % to the total energy consumption in glass production.

The most important aim of TC09 for 2017 was to continue to define a uniform approach for energy efficiency or specific energy usage within or across the various glass industry sectors. With financial support of ICG, TC09 started a project to realize this goal. The reported energy data in the literature do not clearly explain the validity of the reported data. In the first instance TC09 is focussing on glass melting furnaces, the largest energy consumers of a glass factory. TC09 will try to develop recommended Best Practices for defining energy use and efficiency so that companies within each glass sector can make useful comparisons. 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. The first step in this study is an energy benchmark study for 6 to 8 float glass furnaces. Furnace energy consumption of individual glass furnaces will be benchmarked against a database of energy consumption of (anonymous) glass furnaces. Besides, TC09 started a round robin study on comparison of calculating the "thermodynamic energy requirement" for glass melting for some selected glasses.

In 2017, TC09 exchanged information on running projects and new initiatives to reduce energy consumption in the glass production process as well. Many companies applied energy benchmark studies as a starting point of energy reduction programs. To reduce the CO<sub>2</sub> footprint and energy consumption some companies switched from air-fuel to oxy-fuel, while others increased the fraction of electric boosting. New initiatives in the glass industry are for example the application of Organic Rankine Cycle (ORC), Hot-Ox systems to preheat fuel and oxygen, the application of the 'Optimelt' TCR system and the use of smart batches which melt more easily.

**TC11:** Technical committee working on refractory materials and its interaction with the glass melt TC11, aims to discuss the material related problems in glass melting furnaces and the defects generated by these materials like blisters, stones, knots and cords. 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. In 2017 new requirements for refractories for multi-fuel hybrid furnaces, superstructure corrosion behaviour, the defects related crown and superstructure refractories and methods and tools to study crown corrosion and heat losses on refractory walls were the main focused topics of TC 11.

As the next step, evaluation of blistering tests for fused cast materials and evaluation of silica test will be the most important topics of interest of 2018. Further discussion is needed for the possibility for non-destructive measurement of refractory materials.



**TC13:** 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. In 2017, The chairman of TC 13 was changed and Mr. Laurent Piranda from Guardian, was elected as the new chairman.

The committee had the opportunity to be funded on a research topic of particulate emissions from catalytic bag filters. Then dust generated by electrostatic precipitators was addressed with specific discussions on recycling, iron content and pH under different conditions.

The group discussed REACH and CMD regulations in relation to boron leaching from frits and airborne measurements of refractory ceramic fiber. There was also an update on the status of the draft TC13 paper on RCS in sand.

The committee addressed measurement of emissions from glass furnaces, with focus on the determination of emission rates from oxy-fuel furnaces, boron as a deNOx catalyst poison and ammonia (use of FTIR).

**TC14:** Technical Committee working on gasses in glass TC14, 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.

In 2017, as proposed a joint work of TC14 - TC11, the procedures of both static and dynamic Round Robin "Tests on refractory bubbles" have been defined earlier, but the previous results were not satisfied. This joint work will be rediscussed based on the decision of TC11 as mentioned above in the section on 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 structure.

Regarding the activity plan, TC14 chair collected the new ideas and/or proposals from the participants and prepare an agenda to be discussed at the next meeting. Investigations on melting kinetics including batch to melt conversion and bubble nucleation based on glass composition, raw materials, time-temperature regime, as well as bubble refractory material interactions became the subjects given priority.

**TC18:** The title of TC18 recently changed from "Properties of Glass Forming Melts" into "Glass Melting". TC18 promotes both fundamental and applied research on phenomena connected to glass melting processes. It supports co-operation among technical committees involved in the cluster Glass Production.

A new experimental project was planned on batch melting kinetics. The goal of this project is to propose and test simple laboratory procedure to evaluate melting kinetics of glass batches. In the initial stage of the project, suitable test procedures were discussed and an experimental set-up was proposed. Laboratory melts will be run for two to three types of glasses which will be selected for the study – E-glass, soda-lime-silica (container glass) and borosilicate (Pyrex type). Raw materials will be delivered to the laboratories which will take part in the RRT. Melting laboratory tests planned to be

completed before the end of 2018. The evaluation of RRT results is planned at the TC18 meeting during ICG Congress 2019 in Boston, USA.

**TC21:** The main activity of TC21, Technical Committee on Glass Furnace Design and Operation, is to improve the quality and reliability of glass furnace simulation modelling and optimization of software packages of different suppliers and glass producing factories that describe heat transfer, flows and temperatures in glass furnaces (melt, batch & combustion space).

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 different participants to compare and validate results with each other and also with real measured data.

Such a comparison activity is usually referred to as a Round Robin Test (RRT). In the past, TC21 has used several different so called RRTs and has now reached definition RRT5 for a formerly existing furnace with detailed measured data.

At the 2017 meeting, an overview of the committee and its activities was presented. A discussion about modelling the proposed Glass Futures test furnace was held and efforts to keep in contact as they develop plans. During this meeting a brain storming session was carried out, four breakout groups were formed to discuss future activities and needs. Each group reported what they discussed. Improved batch modelling was the main topic discussed during this session with suggestions of RRT and to recommend projects to Glass Trend, universities, companies etc. to improve properties (TC18), simulation of redox, coverage (islands and log formation) etc. Some of the other discussed topics were improving glass quality predictions, sensors, how to share results between companies, NOx control and emissions etc.

### 2.3 CHARACTERISATION – Coordinator: Mathieu Hubert

This cluster comprises 4 TCS: TC02 (Durability and Analysis), TC06 (Mechanical and nanomechanical properties), TC10 (Optical measurement techniques), and the recently reactivated TC19 (Surfaces). The activities of these TCs during the year 2017 were:

**TC02 - Durability and Analysis.** The members met twice during the year, during a telephone conference in March and at the ICG Annual Meeting in Oct. 2017 in Istanbul, Turkey. The TC has conducted proficiency tests on the determination of Chlorine in technical glass and participated in DGG project on "Certification of a soda lime silicate glass for chemical composition and physical parameters (viscosity, annealing point, transformation temperature, CTE)". TC02 plans to participate in the certification of new certified reference materials (CRMs): borosilicate glass for the determination of the hydrolytic resistance acc. to USP<660> (with the German BAM), resistance of technical glass to boiling acid (DIN 12116) and to boiling alkaline solution (ISO 695). Work will also be conducted on method development (analysis of the chemical composition of filter dust, and validation of the application of ICP-MS or ICP-OES for arsenic determination in Ph. Eur. 3.2.1, hydrolytic resistance of glass containers) and in proficiency tests for the determination of low level of fluorine in technical glasses. The organization of a workshop on chemical durability tests and standards is also planned for 2018.

**TC06 – Mechanical and nanomechanical properties.** This TC has been involved in several conferences and publications in 2017. The TC endorsed the International Conference "FFAG-7 – Fracture and Flow of Advanced Glasses" in Aalborg, Denmark, gathering 80 participants and organized a summer school on "Mechanical Properties of Glasses" within the scope of the SPP 1594 program. A symposium on "Glass & Entropy", with a focus on mechanics, was organized during the PACRIM/GOMD 2017 conference (May 2017 in Hawaii). Members of the TC06 have also been strongly involved in the

publication of a special issue of *Frontiers in Glass Science*, “Ultrastrong Glasses: Improving Mechanical Properties of Disordered Solids through Topo-Chemical Engineering”. This issue includes 14 articles in open access and currently counts over 30 thousand views.

TC06 planned activities for 2018 include the execution of Round Robin on scratch testing of blank and surface-modified glasses, and the organization of sessions on mechanical properties of glass at both the GOMD conference (May 2018, San Antonio, USA) and at ICG Annual Meeting at Yokohama, Japan (Sept. 2018). The TC members have planned business meetings during these events as well. In addition, TC06 will be conducting two Young-Researcher-Days events, in Feb. 2018 in Hannover, Germany, and in Sept. 2018 in Jena, Germany. The activities of the TC will also include the announcement and promotion of the 2019 workshop on Glass & Entropy (Sept. 08-12, 2019, in Jena, Germany). Funding for this event has already been secured and several invited speakers confirmed.

**TC10** - Optical measurement techniques. The TC held 2 meetings in 2017, on April 28<sup>th</sup> in Venice (Italy) and on Oct. 20<sup>th</sup> in Rosenheim (Germany). Members of the TC10 have been involved in many activities, including solar shading characterization (determination of solar shading devices and textile materials normal-normal transmittance,  $T_{nn}$ ), and a laminate calculation exercise (round robin test on how to calculate laminate glass properties based on component properties and based on annex B of EN410). Members of TC10 also participated in Round Robin Test on transmittance of low iron glasses, focused on results at individual wavelengths used for redox calculations. Another round robin test for the EN410 – EN12898 (Glass in building – Determination of emissivity) was initiated, involving 21 laboratories (TC10 members and others) in 13 countries, and showing good agreement between the different values for emission measured between these different labs. In general, it was observed that the standard deviation for emissivity increase when emissivity decreases. One of the main activities of the TC10 in 2017 focused on the characterization of diffusing glazing and glass products (frit glass, enamel, translucent PVB, patterned glass, etched glass, and combination of these products). The measurement of the optical properties of these products can be very challenging, especially in the infrared, and the TC is actively working on the evaluation and development of measurement techniques. This topic is becoming more and more important for the glass industry, leading to the creation of a task group at the National Fenestration Rating Council, which includes members of TC10 (Jacob Jonsson and Helen Rose Wilson). This topic will continue to be one of the main activities of the TC10 in 2018, together with the reporting on the round robin tests in which the TC10 is engaged and the production of a general overview on emissivity measurement methods. TC members have planned 2 meetings, in Murano (Italy) on April 27<sup>th</sup> and in Mons (Belgium) on Oct. 26<sup>th</sup>. An update of the TC10 website is also planned.

**TC19** – Surfaces. TC19 has been re-activated after being dormant for some years. The list of members has been updated, with a good mix of academic and industrial individuals. Seong Kim (Penn State Univ.) has been elected as chair, together with two vice-chairs, one from industry (Ilkay Sokmen, SiseCam) and one from academia (Matthew Linford, Brigham Young Univ.). Members of the TC met during the PACRIM/GOMD 2017 conference (May 2017 in Hawaii) and discussed several topics, including plans to set up research collaborations and future events (sessions in conference, session at ICG Summer Schools). Discussions around round-robin tests to compare readily available surface characterization techniques (e.g. crystal size of crystalline domains in commercially-available FTO coating on float glass analysis by XRD, EBSD, AFM, etc.)

Members of TC19 plan to meet during the ICG Annual Meeting at Yokohama, Japan (Sept. 2018) and to discuss synergistic collaboration other TCs focusing on characterization.

## 2.4 APPLICATIONS – Coordinator: Julian Jones

**TC04 Bioglasses** (Chair: Delia Brauer) were awarded best TC website, and videos on the TC04 YouTube Channel have amassed thirty thousand views. 2017's focus was increasing the visibility of glass as a bioactive implant through special issues, e.g. in Applied Materials Today and J. Mater. Sci., books, reviews and conference symposia. A critical review "The role of fluoride in the nanoheterogeneity of bioactive glasses" was published in Phys Chem Glasses. The book "Bioactive Glasses: Fundamentals, Technology and Applications" was published by the Royal Society of Chemistry. Conference activity included plenaries at ICG2017 and Bioceramics 29, which also featured two TC04 Keynotes. TC04 organised a conference symposium at GOMD 2017 in Texas. The TC04 journal Biomedical Glasses continues towards its impact factor.

**TC05 Waste Vitrification** (Chair: O. Pinet) has a main aim to structure and increase their technical programming and dissemination. They organised Symposium 30 at the PACRIM conference, leading to 50 presentations dealing with Glasses for Nuclear and Hazardous Waste Treatment. They also organised the Vitrogeowaste congress in Elche, Spain, for recycling of non-nuclear waste and cement. The aim is to continue the two streams of programming: Nuclear and non-nuclear hazardous waste vitrification.

**TC12 Pharma Packaging** (Chair: Massimo Guglielmi) was very active and succeeded in raising awareness of delamination in glass pharmaceutical containers, in the glass and pharma industries, through round robin tests on different type of vials that were subjected to autoclaving cycles. Electron microscopy showed some flaking at the bottom inner surface of the vials. A meeting was held in Padova in October 2017, resulting in a manuscript draft that will be submitted to Journal of Pharmaceutical Science and Technology. TC12 will also examine what ions may be released from the vials into their cargo.

**TC16 Nanostructures** (Chair: Rui Almieda) focused on a CTC-funded collaborative research project between the universities at Padova and Lisbon "Nanocrystalline sol-gel coatings for solar energy applications", wherein the sol-gel method was used to prepare multi-component films with complex structures. Sol-gel processing was used to prepare up- and down-converting coatings based on aluminosilicate glass doped with rare earths. Solar-control coatings which can reflect the sun light have also been developed.

**TC20 Optoelectronics** (Chair: Gian Carlo Righini) focused Special Issues (SI), collaborative EU projects and conference presence, particularly in the organization of PRE'17, 7<sup>th</sup> International Workshop on Photoluminescence in Rare Earths: Photonic Materials and Devices; 17<sup>th</sup> International Conference on Optical Fibers and Their Application, Poland; a symposium at PACRIM 12 and the 5<sup>th</sup> Workshop on Specialty Optical Fibers and Their Applications, Cyprus. SIs featured in: Fibers, entitled "Advances in Optical Fibers II" which included a TC20 review of next generation of optical fibers; Optical Materials Express, entitled "Advanced Multimaterial and Multifunctional Optical Fibers"; Optical Materials, entitled "Photoluminescence in Rare Earths 2016: Photonic Materials and Devices".

**TC24 Coatings on glass** (Chair: Joop Van Deelen) focused on Self Cleaning and providing input into ongoing standardisation activities now being undertaken by CEN TC129 through round robin testing of new techniques that can provide understanding of the relationship between the properties of the films for different technical applications.

**TC28 Glass fibres for reinforcement and insulation** (Chair: Yuanzheng Yue) is a new TC, focusing on glass fibers for reinforcement and insulation. Aims include finding alternative raw materials; composition and process design for higher quality/greater functionality fibers made using less energy

and producing less emissions. There was a TC28 symposium at 11<sup>th</sup> Advances in Fusion and Processing of Glass Symposium in Columbus, USA.

## **2.5 INFORMATION, EDUCATION, HISTORY – Coordinator: John Parker**

TC01 (Communications) and TC23 (Education) continue to be very active committees. TC17 traditionally concentrates its activity on the ICG Congresses so 2017 has been a fallow year, 2019 being the date of the next Congress. Four members of the committee though did participate in the C2RMF *International Symposium of Glass Degradation in Atmosphere* held at the Louvre, Paris, all presenting papers.

An important development for TC01 last year has been to provide list of instructions for uploading information onto the new site to TC Chairs, explaining how they can add their own information to the web. For the first time we asked TCs to submit their Annual Reports directly to the web. Several web sites are benefitting from this personal touch and a few committees are beginning to store their files on the password protected areas of the web site. The one difficulty of this approach is archiving the information uploaded on an annual basis.

Improving the communications strategy and maintaining the ICG web site are central activities of TC01. These will continue for the next year. A book to celebrate to 10<sup>th</sup> Anniversary of the Montpellier Summer School will also be published

TC23 has experienced a change of chair. Prof Conradt reached the end of his nine year term and was replaced by Ana Rodrigues of the Federal University of São Carlos, Brazil at the 2017 conference in Istanbul. A new core team with 7 members was appointed.

It is the mission of TC23 to organize courses, workshops, and schools related to glass science and technology, to provide information on such events organized by others, and to explore both well-established and new formats of instruction.

Under the TC23 banner during 2017 successful schools have been organised in Kolkata, India (January), Montpellier, France (July), Wuhan, China (November) and Sao Carlos, Brazil (also in November). Press releases describing these events were widely circulated. TC23 also considered the ideal content of short courses.

Further courses are planned for 2018 including the 10<sup>th</sup> Summer School in Montpellier and the 4<sup>th</sup> School in Wuhan, China. A second “CeRTEV course is also planned to be held in São Carlos, Brazil, in November 2018.







Decisions on the following persons/functions were taken:

H. Inoue took over as CTC Chair at the meeting in Shanghai (2016).

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](http://www.icglass.org).