

Review of the International Advisory Board (IAB) members about the CeRTEV activities in the previous 3-4 years

The CeRTEV - IAB is composed by 22 members: 6 from industry and 16 from university. They are all well-known glass scientists. Since 2013, we have held 5 meetings: 1 in Aachen, Germany, 3 in the USA (St. Louis, Miami and Madison) and 1 in São Carlos, Brazil. Except for 3 members, all the others have attended at least one of those meetings. In addition the CeRTEV faculty and students have actively collaborated in different scenarios (editorship of journals, co-authorship in articles, co-organization of scientific conferences, student exchange, etc., with several members: Joe Zwanziger, Arun Varshneya, Mark Davis, Joachim Deubener, Vladimir Fokin, Juern Schmelzer, Aldo Boccaccini, Annie Pradel, Steve Martin, Y. Yue, Leonid Glebov, Bruce Aitken, Wolfram Hoeland, and Shingo Nakane.

We list below our invitation letters and their review reports about our activities.

Le 28/04/2017 17:48, Dr Edgar Dutra Zanotto a écrit :

Dear **all**

You have been active IAB members of CeRTEV. This is a friendly reminder about my previous message (copied below). We really need your opinion, a short report, comments, i.e. a "macro" analysis about CerteV's activities in the past 4 years, and suggestions for the future, that will be included in our proposal to extend the CeRTEV funding for six more years. We will not be able to submit the 4th report - which will be used by Fapesp in their analysis to extend the funding - without your short reports.

I look forward to hearing from you soon, and to seeing you in Hawaii next month and/or in Curitiba in July!

THANK YOU!
EDGAR

PS: Just to remind you, the 9 CeRTEV PIs are:

- 1 Edgar D. Zanotto- [dynamic processes, crystallization and properties of oxide glasses](#)
- 2 Helmut Eckert- [glass structure and properties](#)
- 3 José F. Schneider - [glass structure and properties](#)
- 4 Ana C.M. Rodrigues (education and outreach coordinator)- [Electrical properties](#)
- 5 Eduardo B. Ferreira (technology coordinator)- [Glass technology, crystallization and properties](#)
- 6 Oscar Peitl- [bio active glasses and glass-ceramics](#)
- 7 José Pedro Rino - [MD simulations](#)
- 8 Andrea de Camargo - [optical properties](#)
- 9 Marcelo Nalin- [optical properties](#)

The other 5 members are collaborators who only work part time in some of the CeRTEV research projects.

CeRTEV renewal process for 2018-2024

Dear CeRTEV-IAB members

I hope you are all doing well.

I sent you the CeRTEV research output in the period June 2015 – June 2016 a few days ago. I am now forwarding the overall report for that period (I believe I had already sent this report to you last year).

As we prepare for this year's report, which will be evaluated by Fapesp for a 6-year renewal, we will need a review from each one of you regarding our activities in the previous 3-4 years. Most of you have been quite active and attended some of our annual board meetings (during the GOMD in St. Louis, Miami and Madison, and in São Carlos), so we believe you already have a macro feeling about the CeRTEV. FAPESP demands your reviews, with your comments and suggestions for improvement, etc., **which is a compulsory item in our upcoming report.**

So Helmut and I (and all the other 7 PIs and 5 collaborators) would greatly appreciate to receive your **overview reports regarding our science, technology, education and outreach activities in the period July 2013- June 2016.** Only 15- 30 lines from each one of you would be sufficient, but please feel free to write as much as you want to.

THANK YOU VERY MUCH!

Edgar
<http://www.certev.ufscar.br>

1- From J. Schmelzer

I could follow the research and development activities of Prof. Edgar D. Zanotto and his coworkers and students for an expanded period of time (since the crystallization conference in Florianopolis in 1996 organized by Edgar Zanotto) and was always enjoying the high professionalism and engagement in the analysis of different aspects of the vitreous state and crystallization processes proceeding in such states and their precursors. This very broad circle of research activities has been advanced to a new level with the establishment of CeRTEV and the work in the framework of this program. The highly impressive results are outlined in detail in the report and I deeply support the idea to continue these activities for a similar period.

In recent years, we have performed a variety of common studies based on previous common work

- V. M. Fokin, A. S. Abyzov, J. W. P. Schmelzer, E. D. Zanotto: Stress Induced Pore Formation and Phase Selection in a Crystallizing Stretched Glass, *J. Non-Crystalline Solids* **356**, 1679 (2010).
- V. M. Fokin, E. D. Zanotto, J. W. P. Schmelzer: On the thermodynamic driving force for the interpretation of nucleation experiments, *J. Non-Crystalline Solids* **356**, 2185 (2010).
- J. W. P. Schmelzer, V. M. Fokin, A. S. Abyzov, E. D. Zanotto, I. Gutzow: How do crystals form and grow in glass-forming liquids: Ostwald's rule of stages and beyond, *International Journal of Applied Glass Science* **1**, 16 (2010).
- V. M. Fokin, R. M. C. V. Reis, A. S. Abyzov, C. R. Chinaglia, J. W. P. Schmelzer, E. D. Zanotto: Non-stoichiometric crystallization of lithium metasilicate - calcium metasilicate glasses. Part 2 - Effect of the residual liquid, *J. Non-Crystalline Solids* **379**, 131 (2013).

I added them as a supplement to the overview given in the report. One of the main directions of common research and results of last years are given in the report in the list of references [1,3,4] and described there in detail.

In one of the CeRTEV meetings Edgar formulated also the problem concerning the dependence of the work of critical cluster formation on supercooling. Meanwhile already two common papers are published on this topic (the first one mentioned also in the report as [5])

- A. S. Abyzov, V. M. Fokin, A. M. Rodrigues, E. D. Zanotto, J. W. P. Schmelzer: The effect of elastic stresses on the thermodynamic barrier for crystal nucleation, *J. Non-Crystalline Solids* **432**, 325 (2016).
- V. M. Fokin, A. S. Abyzov, E. D. Zanotto, D. R. Cassar, A. M. Rodrigues, J. W. P. Schmelzer: Crystal nucleation in glass-forming liquids: Effect of the size of the "structural units", *J. Non-Crystalline Solids* **447**, 35 (2016).

This research was advanced accounting for effects of spatial inhomogeneity of the melt on crystal nucleation

- A. S. Abyzov, V. M. Fokin, N. S. Yuritsyn, A. M. Rodrigues, J. W. P. Schmelzer: The effect of heterogeneous structure of glass-forming liquids on crystal nucleation, *J. Non-Crystalline Solids* **462**, 32-40 (2017).

Classical nucleation theory – based on the classical Gibbs theory of heterogeneous systems – assumes that the properties of the critical clusters are widely identical to the properties of the evolving macroscopic phases. In a number of cases, this assumption is a reasonable approximation, in a variety of cases not. From a theoretical point of view, the deviations of the properties of critical clusters from the properties of the evolving macroscopic phases can be described by the developed by us generalized Gibbs approach. This approach was so far applied by us to a quantitative description of condensation and segregation and to qualitative analyses of its influence on crystallization. In order to see whether the mentioned by Edgar Zanotto problems can be resolved by applying the generalized Gibbs approach in a quantitative form to the interpretation of nucleation experiments, the main equations for the description of crystallization in terms of the generalized Gibbs approach have been developed in recent years. They are published in the invited by the editor paper

- J. W. P. Schmelzer, A. S. Abyzov, V. M. Fokin: Crystallization of glass: What we know, what we need to know, *International Journal Applied Glass Science* **7**, 253-261 (2016).

and in the details in

- J. W. P. Schmelzer, A. S. Abyzov: Crystallization of glass-forming liquids: Thermodynamic driving force, *J. Non-Crystalline Solids* **449**, 41-49 (2016).
- J. W. P. Schmelzer, A. S. Abyzov: Crystallization of glass-forming liquids: Specific surface energy, *J. Chem. Phys.* **145**, 064512/1-11 (2016).

The application of this new theoretical tool to the quantitative interpretation of experimental data on crystallization is a principal new problem with a wide spectrum of possible applications. We hope that it will be possible as a result of the common work in the next period of CeRTEV to arrive at a comprehensive solution of this complicated task. Other common research topics can be advanced similarly as well.

Summarizing, I highly evaluate the achievements of CeRTEV obtained in the previous period of work on the project; I greatly enjoyed the stimulating and fruitful cooperation, and highly recommend continuing financing for the next period.



Dr. rer. nat. habil. Jörn W. P. Schmelzer Rostock, Germany, April 20, 2017
27 April 2017



Nagaoka University of Technology

Nagaoka, 940-2188 Japan

Evaluation Report for CeRTEV Research Activities

30 April, 2017

Dear Prof. Edgar Dutra Zanotto

I evaluate the CeRTEV research activities (2013-2016) as a member of the international advisory board. I understand that one of the most important agenda in CeRTEV research is to develop new functional glasses and glass-ceramics leading the innovation and technology transfer in Brazil. In order to achieve this purpose, the local structure of glasses and the nucleation/crystal growth kinetics must be understood deeply and quantitatively, because the functionalities of glasses and glass-ceramics are closely related to them. In this point of view, the CeRTEV research activities are excellent, in which the concept of fragility in glasses (nano-scale local glass structure) has been considered in the nucleation/crystal growth kinetics and more detailed local structures in various precursor glasses having high potential for advanced functional glass-ceramics such as bioactive and ion conductive glass-ceramics have been clarified. Many excellent results have been obtained in the activities, and the CeRTEV research leads the world in the design of new functional glass-ceramics with high reputations and evaluations.

In Li^+/Na^+ ion conductive glasses (e.g., $\text{Li}_{1+x+y}\text{Ti}_{2-x}\text{Al}_x\text{Si}_y\text{P}_{3-y}\text{O}_{12}$ (LATP)), there has been a great progress through the CeRTEV research activities. These results (the title: Ionic Conducting Nasicon Glass-Ceramics as Solid Electrolytes) were reported in the conference of 1st International Symposium on Future Innovative Reliable Materials in Japan and received much attention. I suggest that secondary Li^+/Na^+ ion battery performance of these glass-ceramics in all solid state batteries would be clarified in the next CeRTEV renewal process.

Sincerely yours

Prof. Takayuki Komatsu

Nagaoka University of Technology

Nagaoka 940-2188, Japan

Tel.: +81-258-47-9313, Fax: +81-258-47-9300

E-mail. komatsu@mst.nagaokaut.ac.jp

----- Mensagem encaminhada -----

Assunto:RE: CeRTEV report 2015-2016 / IAB evaluation - EXTREMELY IMPORTANT for the renewal proceed. Please respond by labor day!!!!

Data: Tue, 2 May 2017 14:06:24 +0000

De: Aitken, Bruce G Dr <AitkenBG@Corning.com>

Para: dedz <dedz@ufscar.br>

Edgar:

I think it would be good to encourage some collaboration between Andrea and Marcelo as they are both interested in optical properties and this would help to overcome the small but real geographic separation between Sao Carlos and Araraquara.

Hope you like this version of my report;

Bruce

Evaluation of CeRTEV activities

CeRTEV's agenda incorporates the three distinct sectors of research, technology and education. In the case of research, five focus areas have been identified: structural materials, bioactive glasses, ion-conducting materials, photonic glasses and catalytic systems. From the standpoint of publications, all five of these research areas show an excellent track record. It is good to see that, of the 78 published articles, more than 20 of these have at least 2 CeRTEV principal investigators as coauthors, indicating a good level of collaborative research within the group, especially the collegial relationship between Oscar Peitl and Edgar Zanotto. Moreover, the fact that about half of these papers have non-Brazilian coauthors demonstrates a high degree of connectivity to the international science community.

On the topic of technology, the frequency of filing of Brazilian patents is very good, particularly in the area of bioactive materials. However, it is concerning that, through no fault of CeRTEV, the analysis of PCT filing at INPI may take 7-10 years – this is far too long. It is also noteworthy that the bioactive glass area is the only one where a spin-off company (VETRA) has been formed. Given the absence of a technical glass (as opposed to container/plate glass) company in Brazil, this is most likely the only way to successfully commercialize CeRTEV's science and so it would be good to have more details on current developments at VETRA and to make all efforts to ensure its success. In my experience with technology transfer at an industrial laboratory, this activity requires someone who is devoted full-time and so it is recommended that either Eduardo Bellini focus most, if not all, of his efforts towards this end or that an individual with marketing experience be engaged to supervise these activities..

Regarding education, CeRTEV is to be congratulated on having already explored many different and creative approaches to raising the visibility of glass and materials science within the Brazilian educational system. Although a book on glass technology in Portuguese is listed under "technology transfer", I believe that it is best placed under this topic. In addition, I think that it is one of the most important tasks to be accomplished in the area of education, whether it be only an on-line publication or a physical book. It seems as though too much of the burden of the writing is being placed on the partnership with Mauro Akerman, and it may be that CeRTEV scientists will have to become more involved in this task.

Overall rating: CeRTEV has made an excellent start to accomplishing its threefold mission and it is recommended that its funding be continued.

Bruce Aitken



Institut für Nichtmetallische Werkstoffe – Professur für Glas und Glastechnologie

Prof. Dr.-Ing. habil. Joachim Deubener
Zehntnerstraße 2A
38678 Clausthal-Zellerfeld
Germany

tel: +49 (0) 5323 72 2463
fax: +49 (0) 5323 72 3710
joachim.deubener@tu-clausthal.de
<http://www.naw.tu-clausthal.de>

Report on activity of CeRTEV in the period July 2013 - June 2016

On the basis of the annual board meetings/reports and exchange of information with several PIs during my sabbatical stay at UFSCar between September 2016 and February 2017, I am able to assess the main activities of CeRTEV with respect to fundamental research, technology and education & outreach.

Fundamental Research

Through this information it becomes clear what outstanding achievements CeRTEV has made over the last three years in the area of fundamental research of glass. The numbers of publications in prestigious peer-reviewed journals is extremely high. In the period July 2015-June 2016 alone, 61 papers were published. These publications were made to a large share by participation of researchers from abroad, which emphasizes the improved international visibility and connectivity of CeRTEV. In particular, papers of exceptional quality are covering the main topics of CeRTEV's research agenda, such as glass structure (6), fundamentals of glass crystallization (8), bioactive glasses and glass-ceramics (15), optical properties (13), electrical properties (11) and chemical and catalytic properties (8).

Technology

Also CeRTEV stood out in developing technologies to prepare and characterize glasses and related materials. In this field of excellence 17 papers and 2 book chapters were published in the last year. Another proof of CeRTEV's successful technology concept can be found in the continuous number of annual patents. In the last year 3 national patents were granted claiming innovation with respect to glass software development and biomaterial processing.

Education and Outreach

PIs of CeRTEV have received increasing international recognition as their number of invited and plenary talks at glass conferences and symposia are steadily growing (22 in 2016). Memberships and appointments in boards, councils and technical committees of international organizations and societies such as ICG and ACerS underline further that their expert opinion is increasingly getting attention.

Further, CeRTEV is getting continuously stronger in the education of undergraduate, graduate and PhD students. To educate students on graduate and PhD level abroad CeRTEV has organized in the last years several seminars at universities and at conference venues in Brazil, Germany and USA. In my opinion their educational activities were highlighted by the Advanced School on Glasses and Glass-Ceramics where almost 100 young researchers were hosted by CeRTEV in 2015. It was likely one of the largest short courses focusing on glass education worldwide and a great success as indicated by the positive feedback received.

In summa, the achievements of CeRTEV in all three areas of research, technology and education are outstanding. CeRTEV has been established as one of the largest and internationally most visible glass groups on the globe. I would like congratulate the PIs for the hard work to achieve this very high level of excellence.

Clausthal-Zellerfeld, May 04, 2017

Prof. Dr. Joachim Deubener

Quebec City, June 2, 2017

Subject: Report of CERTEV activities

Dear Committee Members,

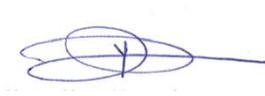
The Center of Research, Technology and Education in Vitreous Materials (CERTEV) is the only center dedicated to glass science in Brazil covering several domains of applications. The research activities developed cover photonic glasses, bioactive glass and glass ceramics, ion conducting materials for energy applications, structural reinforcement materials for architecture and construction as well as dental restoration. The joint research activities of all principal investigators and their colleagues led to a very impressive number of papers, almost 80 articles in high impact journals, which is an indicator of the high quality of the research performed in the various laboratories.

A great number of students, almost 60 graduates and postdocs, are involved in different research activities. In my opinion, this is one of the major achievements of the CERTEV program compared to other research centers around the world. I need to point out that all students also participate in the education and knowledge translation program of basic glass science to address the lack of training in this area. Other activities are also organized by CERTEV such as *The National Week of Science and Technology* (September 20-23, 2015), *The XIII Circus of Science* (May 9-11, 2016) or *The Sao Paulo Advanced School on Glass and Glass Ceramics* (August 1-9, 2015) with the participation of selected graduate students from 19 countries.

Furthermore, I must highlight another major impact of CERTEV activities, which is the great number of research collaborations established by the various members with national and international industries. Such interaction has resulted in several patents such as one related to bioglass for dental use or another on conducting materials for batteries. Other important activities revolved around offering continuous support to companies for glass characterization or for expertise provided to their engineering staff.

Having read in detail the CERTEV activity report, I firmly believe that the social implications and significance of the technological innovation resulting from this center are excellent and impressive.

Sincerely,

A handwritten signature in blue ink, consisting of a stylized, elongated shape with a central vertical stroke and a horizontal stroke, followed by a long horizontal tail.

Younès Messaddeq

Full Professor and holder of the

Canadian Excellence Research Chair in Photonic Innovations

Message from Vladimir M. Fokin, St. Petersburg

The main problems studied by me jointly with CeRTEV members during last five years were:

- 1) Crystallization kinetics (nucleation, growth, and overall crystallization) of non-stoichiometric glasses that includes the precipitation more than one phase or phase catalyzing the formation of proper phase. It should be emphasized that, as opposed to the stoichiometric crystallization, the above-mentioned types of glass crystallization are widespread.
- 2) Quantitative description of the temperature dependence of the experimentally measured crystal nucleation rate in the framework of CNT.

List of joint publications from 2013 up to 2017

1. I. Dyament, A.S. Abyzov, V.M. Fokin, E.D. Zanutto, J. Lumeau, L.N. Glebova, L.B. Glebov *J. Non-Crystalline Solids* 378 (2013) 115–120
2. Vladimir M. Fokin, Raphael M.C.V. Reis, Alexander S. Abyzov, Clever R. Chinaglia, Edgar D. Zanutto; *J. Non-Crystalline Solids* 362 (2013) 56–64
3. Vladimir M. Fokin, Raphael M.C.V. Reis, Alexander S. Abyzov, Clever R. Chinaglia, Jörn W.P. Schmelzer, Edgar D. Zanutto; *J. Non-Crystalline Solids* 379 (2013) 131–144
4. Vladimir M. Fokin, Alexander Kamanov, Alexander S. Abyzov, Jörn W.P. Schmelzer, Edgar D. Zanutto 8 Chapter “Stress-induced Pore Formation and Phase Selection in a Crystallizing Stretched Glass” in “Glass Selected Properties and Crystallization” Berlin : De Gruyter, 2014, p.441-479.
5. Leonardo Sant'Ana Gallo, Tiago De Marchi Mosca, Bruno Henrique Teider, Irina Polyakova, Ana Candida Martins Rodrigues, Edgar Dutra Zanutto, Vladimir M. Fokin ; *J. Non-Crystalline Solids* 408 (2015) 102–114
6. Schmelzer, J.W.P., Abyzov, A.S., Fokin, V.M., Schick, C., Zanutto, E.D., *J. Non-Cryst. Solids* 429 (2015), 24-32
7. Schmelzer, J. W. P., Abyzov, A. S., Fokin, V.M., Schick, C., Zanutto, E. D.; *J. Non-Cryst. Solids* 429 (2015), 45-55.
8. Schmelzer, J.W.P., Abyzov, A.S., Fokin, V.M., Schick, C., Zanutto, E.D. *J. Non-Crystalline Solids* 428 (2015) 68-74.
9. Reis, R.M.C.V., Fokin, V.M., Zanutto, E.D., *J. Am. Ceram. Soc.* **99**[6] (2016) 2001-2008.
10. Vladimir M. Fokin, Alexander S. Abyzov, Edgar D. Zanutto, Daniel R. Cassar, Alisson M. Rodrigues, Jörn W.P. Schmelzer ; *J. Non-Crystalline Solids* 447 (2016) 35–44
11. Alexander S. Abyzov, Vladimir M. Fokin, Alisson Mendes Rodrigues, Edgar D. Zanutto, Jörn W.P. Schmelzer; *J. Non-Crystalline Solids* 432 (2016) 325–333
12. Gisele G. Santos, Francisco C. Serbena, Vladimir M. Fokin, Edgar D. Zanutto; *Acta Materialia* 130 (2017) 347-360

In my opinions the CeRTEV activities are a valuable asset to the international glass community and should be continued!

V.M. Fokin

Report on CERTEV activities (2013-2016)

By

Dr Annie Pradel

Senior Researcher at CNRS, Université de Montpellier (France)

The Center of Research, Technology, and Education in Vitreous Materials (CeRTEV) is a joint effort of the Federal University at São Carlos (UFSCar), the University of São Paulo (USP) and the State University of São Paulo (UNESP), to conduct research in the area of Functional Glasses and Glass-Ceramics. It started in 2013 with the claimed goal to develop activities in three main directions: Research, Technology, Educational and Outreach Activities in an equilibrated and harmonious way.

After four years of running, the results are extremely positive.

In the field of fundamental and academic research, five core areas have been identified: (1) structural reinforcement materials for architecture and construction, armor, as well as dental restoration, (2) bioactive glasses and glass-ceramics for bone healing and growth, (3) ion-conducting materials for applications in modern energy technologies, (4) photonic glasses and glass ceramics, and (5) catalytically active systems. The research carried out at CeRTEV in these fields is extremely active as attested by the large production of papers in international publications (78 in the last year alone), chapters of books, participation to international conferences. The excellent work is internationally recognized as acknowledged by numerous invited and plenary talks at the main conferences (ICG, PNCS, GOMD ACerS, ...) in the field. It is also acknowledged through the titles or awards ("Fellow" of the American Ceramic Society, "George W. Morey Award") that CeRTEV researchers were the recipients of. Moreover, eleven patents were filed in the Brazilian National Institute of Industrial Property (INPI) by CeRTEV researchers, in the course of the first four years of CeRTEV, which attests of the success of the applicative research at CeRTEV.

While the academic and applicative research was already strong before CeRTEV creation, extension towards **industry and technological transfer** required an important effort.

Several actions were pointed out as crucial to develop this activity.

A first action concerned the establishment of cooperation agreements and licensing of on-demand technologies commissioned by industry. Non-disclosure agreements and contracts for technology development have been signed between CeRTEV members and many Brazilian (DMC, CTA, SGD Brazil) and international companies (NEG, Ivoclar Vivadent) among which the most important glass-companies (Corning, Schott). Many others are still under discussion; several will probably succeed and will help in extending cooperation of CeRTEV with industry.

A second action and, while crucial, the most difficult one, deals with the nucleation of spin-off companies from CeRTEV activity. A first one, VETRA, has been launched in August 2014 with the aim to explore two CeRTEV patents on bioactive glasses. It is a great success that needs to be underlined.

In order to bring university and industry closer, a First Workshop University-Industry on Glass Materials, has been organized. It aimed at probing demands on glass science and technology from the national glass industry and other industries with interest on glass and was concluded by the creation of a National Industrial Advisory Board (NIAB) for CeRTEV.

A more practical action to go closer to industry is linked with the efforts to establish facilities for the production of prototypes, on a scale beyond the laboratory.

In the domain of Educational and Outreach Activities, an important task was the development of a technical course "Glass Technology" to educate trained professionals for the glass industry. When CeRTEV was created, such a course did not exist and effort has been carried out in the last four years to organize such event (content, location) with two partners, the ABIVIDRO, (Associação Técnica Brasileira das Indústrias Automáticas de Vidro - Brazilian Association of Automated Glass Industry) and the Paula Souza Center. The first edition of the course is scheduled in 2017.

The educational activity is also directed at younger public including elementary and high school students in the framework of ACIEPE (Atividades Curriculares de Integração de Ensino, Pesquisa e Extensão, - activities for the integration of education, research and extension) events and Circus of Science.

Effort to reach a large public through scientific popularization led to a very original project, the publication of comics on general properties of glasses.

In conclusion, CeRTEV members are very productive in the field of functional glasses and glass-ceramics, whatever the considered activity domain - Research, Technology, Educational and Outreach Activities.

The production is large and varied: publications in international journals, contributed and invited communications in international conferences, patents, contract agreements with national and international companies, organization of workshop to increase links with companies, creation of a spin-off company, creation of a technical course on Glass technology, educational activity towards young public. All this production is the result of a voluntarist policy. The CeRTEV members must be encouraged to continue along these lines.

Report on the activity of CERTEV

Dr. Shingo NAKANE
Nippon Electric Glass Co. Ltd.
Projec Planning Department
Phone : 81 (0)77 537 1312
Fax : 81 (0)77 534 3572
snakane@neg.co.jp

CERTEV dedicate sizeable portions in a glass science of their portfolios to structural reinforcement materials, bioactive glasses, ion-conducting materials, photonic materials, and catalytically active systems. The center has been developing outstanding research supported fundamental studies They already released many original research articles to leading journals in inorganic, physics, and chemistry, at least 6 articles for glass structure, 8 articles for crystallization, 15 articles for bioactive materials, 13 articles for optics, 11 articles for electronics, 8 articles for chemical, and 17 articles for technique for synthesis and evaluation which exert influence a research institute worldwide. In addition of the articles, the research have been presented in many international conferences by the members as invited and keynote lecture, leading to activate glass science internationally (for example, Annual Meeting of ICG Bangkok 2015, 11th International Symposium on Crystallization in Glasses and Liquids Nagaoka 2015, and 24th International Congress on Glass Shanghai 2016). Especially, from industry point of view, fundamental research of glass structure and crystallization are impressive. Understanding of glass structure and crystallization in atomic or nano level to elucidate an appearance mechanism of specific property is difficult by industry themselves because of shortage of good apparatus and technique with well-educated researcher. But CERTEV have done and been supplying the useful outcome in the papers and lectures. Furthermore, the research achievements are not only to academic journals and conferences, but also to patents (4 patents are granted) that have high potential to be able to apply for industries for future.

CERTEV also develops a way for access of glass science to much broader people beyond specialists, especially to young prominent students and scientists by steady efforts with strategy of organizing seminar, short course and events. By the efforts, 15 of Post-docs have involved every year in research projects, and 28 PhD of new researchers in material science have been educated by the project.

In conclusion, CERTEV is world-leading center of glass science in advanced research and education that is recognized internationally.

Otsu Shiga JAPAN, May 10th, 2017

中根 慎護

Dr. Shingo Nakane,

Manager in Nippon Electric Glass Co; Ltd.

Overview reports about CeRTEV in the period July 2013- June 2016

As a CeRTEV-IAB member, I was really impressed by the CeRTEV which was comprised by the top-level experts of Brazil in vitreous materials. During the past three years, these groups of CeRTEV worked together effectively and continually produced so lots of high-level researches in fundamental studies of vitreous materials and experimental characterization methods, bioactive glasses and ceramics, ion-conducting glasses and glass-ceramics for applications in modern energy technologies, photonic glasses and glass-ceramics. These fruitful high-level researches and active international communication makes the CeRTEV well-known in the world, obviously promoting the position of Brazil in the world in the field the vitreous materials.

I was also impressed strongly by the Tech Transfer of CeRTEV. CeRTEV's research achievements are channeled into innovation, all the way from new technologies and patents, to new products and processes. The CeRTEV also has perfect education strategies and executed very well in past years, in both *Group A* (development of professional qualifications in glass science and technology) and *Group B* (diffusion of basic and glass science).



Long Zhang,

Professor
Head, Key Laboratory of Materials for High Power Lasers
Deputy Director, Shanghai Institute of Optics and Fine Mechanics
Chinese Academy of Sciences
Tel.: 86-21-6991 8196
E-mail: lzhang@siom.ac.cn

Review - CeRTEV activities: July 2013 – June 2016

The Center of Research, Technology, and Education in Vitreous Materials (CeRTEV) covers a wide range of important competences in the field of glass and glass-ceramics research as well as important adjacent areas. This interdisciplinary cooperation promotes synergy and makes it a truly effective organization.

The definition of five core areas of research, which represent the fields of application with the highest potential for glasses and glass-ceramic materials, prove the applied and industry relevant character of the CeRTEV. Besides rather traditional fields of applications such as dentistry or as structural reinforcement materials, there are also research activities of the group with respect to future technologies. The ongoing networking and digitalization of society, for instance includes rapidly growing requirements for materials used in electronics. The groups research on ionic conductivity as well as photonic glasses and glass-ceramics coincide well with this trend. Furthermore, the strategy followed with the research on catalytic active materials, e.g. for the conversion of biomass into fuel and fine chemicals, can become a valuable key technology to alternative and sustainable sources of energy for the Brazilian industry. Besides this research projects, which serve rather long-term and future technologies, regional projects such as the cooperation with the Ceramic Center of Brazil (CCB), seem to be a promising direction of the CeRTEV with an immediate and considerable value for the Brazilian industry.

The material research within the defined core areas is based on sound competences of the CeRTEV in particular fields of condensed matter sciences. For instance is the development and enhancement of methods for the structural characterization of glasses and glass-ceramics, for instance by means of NMR studies, an important prerequisite for better understanding the mechanisms of nucleation and crystallization of glasses. This is, among others, a field where the CeRTEV is successful. In general has the group not only published a considerable number of original research papers in highly recognized scientific journals, but has also contributed to the field by providing comprehensive and sound review articles. These articles display valuable aids to orientation for any researcher in the field.

Positively highlighted should also be the efforts of the CeRTEV put into the education of young academics including the use of new media such as YouTube. Furthermore, the development of a technical course “Glass technology”, which addresses the lack of vocational training in the field, is an important prerequisite for a sustainable technology transfer.

Since the potential of glass-ceramics for technical applications is still far from being completely exploited, the training of mechanical engineers specifically in the field of engineering with glass-ceramics, could be, among others, a promising future challenge for the CeRTEV.

Markus Rampf
Teamleader - Technology Inorganic Chemistry
Ivoclar Vivadent AG
Bendererstr. 2
9494 Schaan, Principality of Liechtenstein

Aalborg, May 7, 2017
Comments on CeRTEV

As an international advisory board member, I have been closely following the development of CeRTEV, been interacting and collaborating with the investigators of CeRTEV by attending the board meeting and writing joint papers in the past 4 years. Therefrom, I am deeply impressed by their substantial accomplishments achieved in such a short period. My general comments on CeRTEV are as follows.

Research

CeRTEV has conducted highly original, first-class research in the area of vitreous materials, and has become one of the world-leading research bases in glass research. They have established six major research strongholds: glass structure, crystallization, bioactive glass and glass ceramics, optical and photonic glasses, electrical properties, chemical and catalytic properties. These strongholds are well distinguished from those of other glass research groups or centers in the world. Many of their research activities, particularly regarding glass crystallization, glass-ceramics and glass structure, are in the frontiers of glass science.

CeRTEV has a very strong international network and impact. Through collaborations, they have generated many original research ideas and directions, especially in the interdisciplinary area of vitreous materials research. The center has become an open center that have been attracting both senior and young scientists from around world. In parallel, the researchers of CeRTEV have been very actively engaged in international glass science communities and conferences. This is reflected by the fact that the principal investigators of CeRTEV have given numerous plenary and invited talks at international conferences and their key positions in scientific organizations.

CeRTEV has made great contributions to educating young researchers by organizing conferences, workshops, PhD courses, and other events. They put high values on connections between glass science, technology and education.

Technology and Innovation

CeRTEV has made great progress in transforming their scientific findings and results into industrial technology and innovation. This was done by taking the visionary strategy: establishing cooperation agreements with industry; attempting to build spin-off companies; and promoting technology transfer.

They have chosen several future-oriented fields, where their research outcome can be applied. They have related their glass research to energy technologies (high-energy storage devices) and to environmental and health sectors in order to build a sustainable society. They are actively building close contacts between CeRTEV and the Brazilian and local economy. I found it very important and promising that part of the master and doctoral projects of CeRTEV were and still are carried out in the laboratories of their industrial partners to bridge the gap between academic research and industrial technology. By doing so, students have learnt the skills for their potential career in industry.

Education and Outreach

CeRTEV has made substantial effort in developing education and outreach programs as described in its research progress report. They have already educated some trained professionals for the glass industry by organizing the technical course "Glass Technology". At the same time, the center staff has been promoting the diffusion of basic science and glass science by taking advantage of their strong academic experiences, laboratory conditions, and solid basic science knowledge. It is particularly inspiring that CeRTEV has launched a variety of activities to stimulate the interest of junior students to study vitreous materials science and to develop new glass technology. These students are expected to be the main driving force of long-term glass research and technology development in Brazil and in world. Furthermore, the education programs and experiences of CeRTEV have important reference values for other institutions in the world.

Perspective

I firmly believe that CeRTEV will continue to be a successful leading research center in the world since they have visions and strong program, and especially they have built outstanding research team and collected strong positive experiences in the past four years. I sincerely wish that CeRTEV would continue to play a key role in enhancing the development of glass science and technology not only in Brazil, but also in the world.

Yuanzheng Yue

<http://www.en.bio.aau.dk/research/chemistry/center-for-amorphous-materials>



Friedrich-Schiller-Universität Jena

Friedrich-Schiller-Universität Jena – Fraunhoferstr. 6 – D 07743 Jena

Otto-Schott-Institut für Materialforschung

Chemisch-Geowissenschaftliche Fakultät
Fraunhoferstr. 6 D - 07743 Jena

Telefon: (0 36 41) 9 - 4 85 01
Telefax: (0 36 41) 9 - 4 85 02

Christian Rüssel
Prof. Dr. rer. nat. Dr.-Ing. habil. Dr. h.c.
Lehrstuhl Glaschemie I

E-Mail: ccr@uni-jena.de
<http://www.glas1.uni-jena.de>

Jena, 03.05.2017

Overview Report

On

The Center of Research, Technology, and Education in Vitreous Materials (CeRTEV)

I would like to give a short overview on the progress of the center organized by the Federal University of São Carlos (UFSCar), the University of São Paulo (USP), (both located in São Carlos) and the State University of São Paulo (UNESP, Araraquara)

First, I should state that I highly appreciate the formation of this center since research on glassy materials and materials derived hereof, is internationally not widely enough represented in comparison to the relevance to science and also to industrial production. From my opinion, there are worldwide not enough centers attributed to these important topics.

In **CeRTEV**, the principal investigators are well reputed scientists which belong to the world leading scientists in their field. Here especially structural analyses and nucleation and crystallization of glass are to be mentioned.

The particular topics are well chosen and among the currently most interesting in the field of glass: structural reinforced materials, bioactive glasses and glass-ceramics, ion-conducting materials for energy technologies, photonic glasses and glass ceramics, and catalytically active systems. All these topics are of high scientific as well as of industrial importance.

SAXON GLASS TECHNOLOGIES, INC.

200 N. MAIN STREET, P. O. BOX 575, ALFRED, NY 14802

Phone (607)587-9630

Fax: (201)855-0643

May 02, 2017

Dr. Edgar Zanotto
Director, CeRTEV
Brazil

Subject: My observations on the activities of CeRTEV 2014-2016

Dear Edgar:

As a member of your Advisory Board, it is indeed my duty to provide you some feedback on your activities past three years.

CeRTEV stands for Center for Research, Technology and Education in Vitreous Materials and was formed in late 2013. It is a result of collaboration between two São Paulo state universities (USP and UNESP) and the Federal University of São Carlos. The Center's mission is to "conduct advanced research", "educate in advanced sciences", "develop advanced technologies for transfer" and to "initiate outreach programs", all in the area of glass engineering science.

I will summarize my review as "Areas of Strength" and "Areas for potential growth".

Areas of Strength

- (1) *World recognition.* With 14 faculty (9 PI's and 5 collaborators), 60 students and post-doctoral students, you seem to have achieved a global recognition as an advanced center for glass science education and research. In this respect, I think you are the *new* Alfred University. Your instructional courses at the Bachelor's degree level are well-designed. I am pleased to note that you invited professor Gupta of Ohio State Univ to deliver a PhD level course on glass
-

transition range. That demonstrates your desire to get the best education for your students.

- (2) *High level of individual recognition.* I notice with pleasure that your faculty has received many of the most coveted international awards during the past 3 years building upon your own 2012 Morey Award of the Glass & Optical Materials Division of the American Ceramic Society. Professor Eckert was also presented the Morey Award in 2016. *Two from the same institute within 4 year span! Amazing!*
 - (3) *High level of intellectual output.* Again, I notice with pleasure that CeRTEV faculty has published more than 200 peer-reviewed articles and several patents on glass and glass-ceramics in well-recognized technical journals in the past 4 years.
 - (4) *Excellent research programs.* Your concentration is in the area of traditional glass science and glass-ceramics with emphasis on biomaterials. You clearly rank first in the world with keywords involving nucleation, crystallization in glass and glass-ceramics; a first on NMR and glass (H. Eckert); and a high ranking (11th) in bio and glass-ceramics. There of course are other research programs, such as in ion-conducting glasses, which are well recognized.
 - (5) *International collaborations.* I am pleased to note that you have several wonderful collaborations with outside-Brazil industry and universities. Many of your visitors come to Brazil; some more than once.
 - (6) *Outreach programs.* Of course, you are presenting short courses at professional meetings for the industry professionals, and have joined hands with me to teach a broader glass science course at the Society of Glass Technology Centennial Celebration, September 2016 in Sheffield. However, your outreach to the young is much more admirable. Education indeed starts at an early age. Many of your efforts to bring the magic of glass science to high school-going children are well received. I have personally heard your descriptions of glass containers and music which I found totally entertaining. There are other tidbits you have described about glass which make a great impression on young minds. Thank you for being an emissary for the glass world.
-

Areas for potential growth

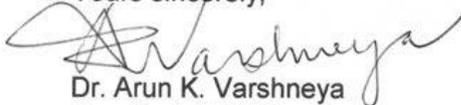
- (1) *Mechanical properties and ballistic behavior of glass.* Glass products often lose out against other materials because of their poor mechanical behavior. Yet, for items such as windshield transparencies, there are no other options. This area of engineering science could use attention. In particular, you perhaps need to find funding to support a dedicated ballistics testing laboratory.
- (2) *Technology transfer.* Govt. funding is always keyed to economic growth through increased jobs. This comes from transferring the technology developed to existing or to locally spawned small businesses. Although you have a reasonable patent record, in particular in the area of dental ceramics, three years are actually too short. Perhaps, with some more attention, you would be able to take a more proactive role in economic growth of your region.
- (3) *Glass science book effort.* OK, here I should suggest to you that, rather than re-inventing the wheel, you should organize a group at your institute to translate *my* book in Portuguese! Please be advised that the writing of a third edition of my book is being launched with some co-author/authors. The book will be written specifically for cyber-friendly style with links to technology videos along with an instructor's manual. A Chinese translation is planned. Why not a Portuguese translation?

In closing, I must say that you have done well. FAPESP couldn't have found better use for their money! I also wish that we could set up a formal collaboration between CeRTEV and Saxon Glass Technologies, Inc. Let us hope the same will come through soon.

If there are any items that you wish to discuss more, please let me know.

Best wishes,

Yours sincerely,



Dr. Arun K. Varshneya
President & CEO

Evaluation of CerTEV: 2013-2016 Period
Josef W. Zwanziger
Dept. Of Chemistry, Dalhousie University
Halifax, NS B3H 4R2 Canada
IAB member

Summary:

CerTEV continues to be a very active entity in glass science internationally. CerTEV members are regular contributors at the major glass conferences, and publish extensively. Furthermore, as an IAB member I have travelled to Brazil several times to see their operations and hear about their local activities, in particular education and outreach, and I remain very impressed with the breadth and energy of their operation.

Science:

The scientific output of CerTEV is both of high quality and large quantity. These are very active researchers who also publish regularly in internationally known journals, and their work is of a very high standard. I have been particularly impressed among their recent publications by their work on photo-thermo-refractive glass—this is very important material technologically, and their work is greatly enhancing our understanding of how it works. Likewise, their recent work on crystallization physics, while more fundamental, is also critical for moving the field forward. Because of my own interests I am a bit less familiar with work in the bioglass and laser glass fields, but am pleased and impressed by the body of work being developed.

Technology:

It appears that CerTEV is active in commercialization and technology transfer, with an emphasis on very early stages of the process (that is, developing ideas at the academic laboratory level and then seeking industrial partners for further exploitation). This seems like the right approach. A concern I've felt with CerTEV is that the grant they operate under seemed to be requiring them to do absolutely everything: academic research, full scale industrial work, full scale educational work, etc etc. No one group can or should do all that. As primarily an academic enterprise, CerTEV is particularly excelling at academic research and education. Their tech transfer activities are very good and I view them as an additional bonus, beyond what should be the core mission for this group.

Education and Outreach:

They are doing an incredible job of this, with lots of exciting and imaginative programs aimed at all ages and backgrounds. It's very refreshing to see this, especially given how to most people glass is not thought of as an "exciting" or novel material. They are doing a lot to change this perception and I would think attract newcomers to this field of work.

College of Engineering
Materials Science & Engineering
2220 Hoover Hall
Ames, IA 50011-2300
Phone: 515 / 294-1214
FAX: 515 / 294-5444
mse@iastate.edu
<http://www.mse.iastate.edu>

May 2, 2017

Center for Research, Technology and Education in Vitreous Materials
Department of Materials Engineering Federal University of São Carlos

Report on Fundamental Research, Technology, and Education and Outreach Activities for 2017 of CeRTEV

Overview: It is clear from the extensive and impressive annual report provided to me that the glass research and education center CeRTEV has accomplished a great deal this past year. The research accomplishments are indeed impressive, the education and outreach efforts are very significant in amount and outstanding in quality and impact. The Technology development activities are exceptionally strong for a primarily university based effort. Overall, the CeRTEV center is to be greatly congratulated for their enormous and impactful achievements this past year and this all bodes extremely well for their continuing levels of exceptional contribution to glass science, engineering, technology develop and education and outreach for the coming year.

Fundamental Research

There are five main research focal areas for CeRTEV: (1) *structural reinforcement materials* for architecture and construction, armor, as well as dental restoration, (2) *bioactive glasses and glass-ceramics* for bone healing and growth, (3) *ion-conducting materials* for applications in modern energy technologies, (4) *photonic glasses and glass ceramics*, and (5) *catalytically active systems*. In each of these areas, the CeRTEV faculty, staff, and students have made significant achievements and accomplishments. Of particular note, is the strong contributions in the fields of glass ceramics, glass characterization, bioactive glasses and ceramics, and photonic materials.

Technology

The CeRTEV group has indeed contributed a significant level of activity related technology transfer. The group has published an impressive number of patents resulting from their research and established a very large number of industrial collaborations and partnerships with the glass industry. In addition to this, the CeRTEV group has spun off a very large number of small startup businesses and this level of accomplishment in this area is quite impressive.

Education and Outreach

The CeRTEV group has accomplished an enormous amount in the area of education and outreach. They have organized and delivered a very large number of educational activities and programs for K-12 groups. They have established new forms of informal science education through their comic strips and books. They have contributed a very large number of formal university classes and laboratories in glass science and engineering. They have organized and established very impactful web sites and other educational materials related to glass science and engineering. They have organized and help professional level short courses on glass science and engineering at international glass science and engineering conferences. All of these programs have been extremely successful and the CeRTEV group is to be strongly commended for the educational impact of these programs.

In summary, the CeRTEV glass science and engineering center has had an enormously productive and impactful year and they are to be commended for all of their significant achievements. I strongly endorse their continued financial and programmatic support.

Sincerely yours,

Steve W. Martin

Anson Marston Distinguished Professor of Engineering
Department of Materials Science and Engineering