# **Center for Research Technology and Education in Vitreous Materials (CeRTEV)**

Summary report July 2013- June 2015

# RIDC Identification (Max. 1 page)

# **Ce**nter for **R**esearch **T**echnology and **E**ducation in **V**itreous Materials (CeRTEV) www.certev.ufscar.br

The core group of the Center comprises 13 professors at USP and UFSCar (both located in São Carlos) and 1 at UNESP (located 35 km from São Carlos) who are experts in engineering, chemistry and physics of vitreous materials, glass crystallization and a wide range of structural and functional characterization techniques. They advise about 50 students and post-docs engaged in glass research and are embedded in a large Brazilian and international network of collaborations. This is likely the smallest group among the 17 Fapesp funded research centers (CEPIDs) in the State of São Paulo, and yet is one of the largest academic “glass” research teams in the world! We are researching and developing new active glasses and glass-ceramics presenting application-relevant functionalities, such as high mechanical strength and electrical conductivity, biological, optical or catalytic activity, and/or combinations of these properties. A fundamental understanding of these properties will be sought on the basis of the structural organization of these materials on different length scales.

ADMINISTRATIVE PERSONNEL

* Ligia Diniz Manager (gestora)
* Sergio Silva Technology Manager
* Karina Lupetti Education and outreach manager

FACULTY

* Hellmut Eckert (**vice-director**) Glass structure, NMR
* José Fabián Schneider Structure, NMR
* Claudio José Magon EPR
* Jose Pedro Donoso Gonzalez EPR
* Valmor Roberto Mastelaro EXAFS, XRD, laser crystallization
* Paulo Sergio Pizani Raman spectroscopy
* José Pedro Rino Molecular dynamics simulation
* Edgar Dutra Zanotto (**director**) Nucleation, crystallization, GC
* Marcello Rubens B.Andreeta Laser crystallization, crystal growth
* Ana Cândida M. Rodrigues (**education coord.)** Electrical properties, conducting glasses
* Oscar Peitl Bio active glasses and GC
* Eduardo Bellini Ferreira (**technology coord.)** Growth, crystallization, GC
* Marcelo Nalin Optical and chemical properties
* Andrea S. S. de Camargo Optical properties, sol-gel

OTHER RESEARCHERS: about 50 students and post-docs and 30 active collaborators.

**International Advisory Board (IAB)**

The CeRTEV IAB has twenty two well-known glass researchers from several countries, including 6 from industry. Eighteen of them have attended at least one of the 3 IAB meetings.

More details can be found at [www.certev.ufscar.br](http://www.certev.ufscar.br)

# 2- Executive summary (Max. 4 pages)[[1]](#footnote-2)

 The CeRTEV comprises 14 principal investigators and their co-workers that advise about 50 graduate students and post-docs. Pursuing the objectives of the CEPID program of the State of São Paulo, CeRTEV’s mission is to conduct state-of-the art ***research***, ***technology*** development, and ***education*** and outreach in the area of Glasses and Glass-Ceramics.

As part of the joint CeRTEV research agenda, the 14 research groups work together to develop new active glasses and glass-ceramics, presenting application-relevant functionalities such as high mechanical strength, electrical conductivity, biological, optical or catalytic activity, and/or combinations of these properties. CeRTEV’s agenda is sub-divided into five core areas, dedicated to the five principal application fields of glasses and glass-ceramics: (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****.* All these application areas benefit from fundamental research encompassing the development of general concepts regarding the structural description of glasses and the structural, kinetic and mechanistic aspects of the nucleation and crystal growth processes involved in the crystallization of glasses leading to glass-ceramics.

A brief summary of the research highlights is given further below; more detail can be found in the annual scientific reports. On the technology side, CeRTEV activities are channeled towards the generation of new technologies and patents, all the way to new products and production processes (“science to business approach”). Thus far, new or improved patentable glass or glass-ceramic materials have been developed in cooperation with various companies in light armors (for use in airplanes, cars and individuals), tougher monolithic glass-ceramics for dental restoration, macroporous and hierarchically ordered scaffolds, fibers, small monolithic parts and powders with increased osteoinductive activities, combined with the ability for targeted drug delivery for bone and tissue repair. Efforts in extending the development of technologies for applications related to the other CeRTEV research areas are underway.

CeRTEV’s education and outreach strategies focus on the development of long-term sustainability of glass science and technology in Brazil. At the present time, the complete lack of training courses dedicated to professionals in the glass industry seriously impinges upon its development. To remedy this situation, we have developed a comprehensive curriculum for a new technical course in cooperation with two professional organizations, the ABIVIDRO and the Paula Souza Center, which will result in trained professionals for the glass industry. In parallel we have mounted a concerted effort promoting the importance of glass and glass-ceramics to the public. Our educational activities include the development of educational kits, mutual visitation projects with high schools, participation in science fairs, design of visually attractive display banners and science comics, as well as theater presentations (“science on stage”).

 During the past two years CeRTEV scientists have published about 100 indexed scientific papers, which up to now have attracted 600 citations. This amounts to approximately half of all Brazilian glass research articles published in the past two years! Patents have been filled in the areas of armor and bioactive glasses. The CeRTEV coordinator, Professor Edgar Dutra Zanotto was recently honored with the Almirante Alvaro Alberto Award (the most important scientific prize in Brazil). He serves as Editor-in-chief for the “Journal of Non-Crystalline Solids”, and Professor Hellmut Eckert, CeRTEV`s vice coordinator, is the Editor-in-chief of the journal “Solid State Nuclear Magnetic Resonance”. CeRTEV has exercised further international scientific leadership by organizing the ***X Brazilian Symposium on Glass and Related Materials***, held in São Carlos during October 26-30, 2014 (approximately 150 participants), and the***São Paulo Advanced School on Glasses and Glass-ceramics*** (with about 100 top international PhD students from 19 countries) during August 1-9, 2015. CeRTEV’s scientific and technological progress is being monitored by an ***International Advisory Board*(*IAB*)**, consisting of 22 international leaders in glass science and industry. During the past two years, CeRTEV’s research progress has been communicated and discussed in three board meetings: April 2014 (Aachen), October 2014 (São Carlos), and May 2015 (Miami) and valuable recommendations from the ***IAB*** have been added regularly to complement our scientific agenda.

A top priority for CeRTEV’s success is the development of a coherent research program aligning the activities of its individual members towards the common CeRTEV objectives. Towards this purpose numerous planning meetings have taken place during the past two years, and joint activities are now in full force. Close to half of our current publication output originates from collaborative research involving two or more CeRTEV faculty members. Below we wish to describe the main lines of our joint research, highlight some key results, and indicate further directions to be pursued within the next funding period. An important example of collaborative synergy within CeRTEV has been the incorporation of solid state NMR spectroscopic methods for elucidating the structural aspects of nucleation mechanisms. While the vast majority of glass forming substances only undergoes surface (heterogeneous) nucleation when sufficiently heated, a few systems also show the thermodynamically less favorable case of internal (homogeneous) nucleation on laboratory time/length scales. Results obtained by advanced solid state NMR techniques suggest a positive correlation between homogeneous nucleation ability and structural similarity at the level of short- and intermediate range order, particularly with regard to the arrangement of the network modifier cations. For understanding nucleation and crystallization processes, molecular dynamics simulations are by now also becoming an increasingly important part of our research agenda, enhancing our understanding about diffusion mechanisms, relaxation processes and dynamical heterogeneities in glass-forming liquids. The development of improved interaction potentials for homogeneously nucleating liquids is an essential part of this effort. On the experimental side, we are continuing our development of new differential scanning calorimetry (DSC) approaches, advanced solid state magnetic resonance methodology and Raman spectroscopic investigations for studying structure/property relations in glasses, as well as crystal nucleation and growth during the formation of glass-ceramics.

In our research effort on ***structural reinforcement materials*,** new mechanistic concepts for the toughening process in lithium disilicate glass-ceramic - crack deflection, crack bowing and trapping, and crack bridging have been developed. A model incorporating the elastic modulus, crystal fracture toughness and crystallized volume fraction was proposed and successfully tested to explain the increased fracture toughness with crystallized volume fraction for the full range of crystallization in glass-ceramics of this composition. Using spectroscopic methods we are continuing our investigations to develop a foundation of this model on the basis of structural and dynamic details on different scales of length and time.

Research at CeRTEV on ***bioactive glasses*** focuses on the continuing improvement of osteoconductive and osteoinductive materials for stimulating bone healing and growth, by developing and testing new bioactive formulations and composites, such as Biosilicate® for applications in bone repair and dental restoration. Recent histopathological, cytotoxicity, and genotoxicity analyses have confirmed that Biosilicate® scaffolds possess excellent biocompatibility. These materials have also been successfully introduced as new additives to calcium phosphate cements (CPCs), which are used as an alternative to biological grafts due to their excellent osteoconductive properties. We are further continuing to explore compositional effects on various aspects of bioactivity performance, in particular with regard to the substitution of Calcium by Magnesium or Strontium, and the examination of boron-containing bioactive glasses.

Glass-ceramics based on lithium titanium (or germanium) phosphate compositions crystallizing in the NASICON structure have shown significant promise for applications as ***solid electrolytes*** in high energy storage devices. The CeRTEV research agenda focuses on enhancing the understanding of composition/structure/performance relationships in these systems. Modern solid state NMR techniques have provided important insight into the influence of the crystalline fraction on the ionic mobility and electrical conductivity. Our investigations are now gradually shifting towards sodium-based glass-ceramics (NTP), because sodium features similar electrochemistry as lithium but is much more abundant than the latter. Along similar lines, we will also explore oxy-chalcogenide glass compositions forming superionic crystals upon ceramization.

CeRTEV’s activities in the area of ***photonic glasses and ceramics*** are focusing on the development and characterization of new systems doped with luminescent species (transition or rare-earth metal ions, metal nanoclusters) for applications in lasers, sensors, and other photonic devices. The structural environments of rare-earth ion species in fluoride phosphate matrices have been studied by newly developed NMR and EPR approaches, leading to an understanding of their photophysical characteristics in terms of the ligand distribution around the rare earth ion species. We will now proceed to the second step of preparing glass-ceramics, based on rare-earth doped fluoride nanocrystals embedded in a glassy environment. Current work focuses on co-doping these glasses with metallic nanoparticles that can potentially enhance the luminescent properties ofdopant ions, due to interaction via surface plasmon resonance. The efficiency of this process is highly dependent on the size of the metallic nanoparticles, whose control is under active investigation. These studies have benefitted greatly from introducing advanced electron paramagnetic resonance techniques. We are also currently applying these methods to understand the initial stages of crystallization in photothermal refractive (PTR) glasses. Another area of active research within CeRTEV is the development of new photonic inorganic-organic hybrid materials and nanocomposites. Besides offering the possibility of designing a more favorable chemical environment to improve the photophysical properties of the guest molecules, encapsulation in the solids also protects such emitter molecules, prevents their leakage (especially critical for biological applications) and ultimately leads to more robust and versatile materials.

An entirely new application field of glass-ceramics is being developed in the fifth topical CeRTEV research area devoted to ***catalytically active systems*** for the conversion of biomass to fuel and fine chemicals. These materials are hierarchically structured combining mesoporosity (for catalytic conversions) with macroporosity (for facilitating mass transport of highly polymerized substrates). Techniques under development include (a) ceramic foaming based on the use of porogenic agents, (b) selective leaching of phase-separated base glasses, and (c) sol-gel techniques using molecular precursors. Catalytic functionalization with niobium or vanadium oxyphosphates is done either by grafting the internal surfaces with suitable precursors or by incorporating the active species already in the synthesis formulation. The catalytic performance of these materials is currently being tested in the batch mode using the cellulose-hydroxymethyl furfural model reaction.

In summary, we expect to have developed the full range of activities in all of the areas delineated in the original CeRTEV proposal shortly, and we have been reaping the first synergetic benefits from results obtained in these different application areas. We anticipate that as the result of our research efforts we will soon have various excellent glass and glass-ceramic systems available for which technological application potentials can be further studied in conjunction with our partners in industry.

# 3- List of innovation and transfer activities with a brief description of each (Max. 2 pages)

CeRTEV’s research achievements are channeled into innovation, all the way from new technologies and patents, to new products and processes (“science to business approach”). Promising new technologies are expected in all the five main fields of the CeRTEV’s agenda above. The CeRTEV strategy for technology transfer is based on ***i)establishment of cooperation agreements and licensing of on-demand technologies commissioned by industry***; ***ii)nucleation of spin-off companies from the group activities***; and ***iii)extensive promotion of innovation and technology transfer***. Further details can be found in the annual reports. An overview of our 2-year achievements is given below.

Several actions were taken to establish cooperation agreements and licensing of technologies. In 2013-2014, Prof. E.D. Zanotto established Non-Disclosure Agreements (NDA) with Ivoclar Vivadent (Liechtenstein), AGY (EUA), and DMC (Brazil). Contracts fortechnology development were signed with the Aerospace Technical Center (CTA), division of Brazilian Aeronautics. Prof. H. Eckert established NDA with Schott (Germany), Corning (EUA), Nippon Electric Glass (Japan) and Ivoclar Vivadent. In 2015, E.D. Zanotto had new NDA signed with Owens-Illinois Glass (USA), and approved a grant from Nippon Sheet Glass. Prof. H. Eckert has on-going research collaborations with Corning and Nippon Electric Glass. New negotiations have started by E.B. Ferreira with Rhodia (Brazil); M. Nalin with Nadir Figueiredo (Brazil); and H. Eckert with Electroglass (Brazil). The project of technical course on glass technology, well detailed in the Education and Outreach Section, was also powerful to approach potential industrial partners. An agenda of meetings and visits to production plants and labs included the companies Cebrace, Pilkington, Nadir Figueiredo, Verallia, Speedtemper, CCDM/UFSCar, LaMaV, CETEA/ITAL, Atelier Pierre Frisch, FATEC, Verallia, Wheaton and **ABIVIDRO**. Further actions for the establishment of cooperation agreements were detailed in the annual report. We will keep considering them in accordance with the research advances made in each area.

In 2013, CeRTEV’s researchers attended the 5th WeekUSPon IntellectualProperty and Innovation. Also the Symposium “*The challenges of invention and innovation in Brazil: experiences of success and failure in the State of São Paulo*” was organized by Prof. Zanotto (Aciesp member) and held at UFSCar, sponsored by the Academy of Sciences of the State of SãoPaulo (Aciesp). Recognized R&D&I authorities presented aspects of their personal experience and discussed with the audience the processes of invention and innovation.

Five patents were filled in the Brazilian National Institute of Industrial Property (INPI) by some of CeRTEV researchers (in Portuguese and having UFSCar as patent holder): **BR 10 2013 017769 5** “*Glass-ceramic compositions, obtained glass-ceramic from the same, armor of sacrifice, and ballistic protection armor*”, L. Sant’Ana Gallo, A.C.M. Rodrigues, O. Peitl and E.D. Zanotto; **BR 10 2013 020961 9** “*Glass composition, fiber and bioactive vitreous fabrics obtained from the same, and articles obtained by the same*”, E.D. Zanotto, M.T. Souza and O. Peitl; **BR 10 2014 003817 5** “*Discontinuous coating process using a bioabsorbable and bioactive biomaterial applied to solid substrates, the discontinuous coating obtained by same and the use of the discontinuous coating obtained by same*”, E.D. Zanotto, C.R. Chinaglia and O. Peitl; **BR 10 2014 032548 4** “*Tubular conduit based on bioactive and bioresorbable glass fibers for regeneration of peripheral nerve tissue and process of obtaining the same*”, E.D. Zanotto, M.T. Souza, O. Peitl; and **BR 10 2014 023349 0** “*Device and method for obtaining fibers by downdrawing of compositions with low glass stability*” E.D. Zanotto, M.T. Souza, O. Peitl. These patents are being analyzed at INPI, which unfortunately may take from 7 to 10 years, and by the UFSCar Innovation Agency for Patent Cooperation Treaty (PCT) applications.

The discussion list in the Internet “*Vidros*” was brought to a more modern and attractive virtual environment, and renamed “***listavidros***” at <https://groups.google.com>. Active people in the glass field has been invited to join and participate, stimulating collaboration and R&D activities between academia and industry. The group has about 160 academic and industrial participants.

In 2014 the first CeRTEV’s spin-off company, VETRA High-Tech Ceramic Products, was established by threeof our post-doctoral researchers, offering glass and GC solutions for bio applications. VETRA requested the licensing of two CeRTEV’s patents and a project of **Innovative Research in Small Business** (PIPE/ FAPESP) is being designed with collaborations of professors E. Zanotto and Oscar Peitl.

In 2014 Zanotto received the award "Pawn of Technology" sponsored by the Technological Park Foundation of São Carlos (ParqTec). Since 1993 this title is awarded to people who have contributed through technological innovation to increase production, quality and competitiveness in companies. The Mechatronics Engineering undergrad student R.H. Carvalho Maria supervised by E.B. Ferreira had his project of automatic machine to cut glass bottles and make sustainable glass cups (*Ecups*) qualified for the final of the 6th 3M Institute for University Students Award, which had in 2015 a record of 240 entries and only 6selected for the final contest.

We plan to write and make accessible in Portuguese a book on Glass Technology, targeting the workers in industry and students in the field. The project, delayed last year due to involvement of our team in the project of technical course on glass technology, will be continued.

Finally, the CeRTEV Technology Transfer Program was presented by E.B Ferreira for the CeRTEV International Advisory Board during the X Brazilian Symposium on Glass and Related Materials in 2014. The IAB Attendees gave several suggestions (detailed in the annual reports), which are being accomplished and being taken into account.

# 4- List of dissemination activities with a brief description of each (Max. 2 pages)

# **OVERVIEW**

The CeRTEV Education and Outreach strategies and plan of action are divided in two main groups: ***Group A* focuses on the development of professional qualifications in glass science and technology, while *Group B* has as its main objectives the diffusion of basic and glass science.**

# **Group A:**

Our main activity in this group is the development of a proposal for a technical course “Glass Technology” to educate trained professionals for the glass industry, in order to address the lack of vocational training in this field. For this project, our partners are the ABIVIDRO (AssociaçãoTécnica Brasileira das Indústrias Automáticas de Vidro - Brazilian Association of Automated Glass Industry) and the Paula Souza Center, an organization of the São Paulo State Government which now administers 214 Technical Schools (ETECS) and 59 Schools of Technology (FATECS) in 163 cities in the state of São Paulo.

The “glass technology” is planned to be a three semester course. The certificate will be delivered to the successful students after three semesters of specialization. Students may start this specialization in parallel to the second year of high school, or at any time if they have already completed high school. The name of the diploma “glass technology” or “introduction to glass technology” is still preliminary.

During the last year, activities on the “curriculum laboratory” were held. Once per week, representatives from the Paula Souza Center and Dr. Mauro Akerman, a specialist in the glass industry indicated by CeRTEV worked together to elaborate the curriculum of all disciplines to be offered in this three semester course. As a result of this “curriculum laboratory”, the description of the “Technical Vocational Qualification in Glass” (Habilitação Profissional de Técnico em Vidro) was proposed, including the details of the disciplines during the three semesters of the glass technology course.

The next step of this activity will be to decide in which city of São Paulo State the course will be installed. This will be a joint decision between Paula Souza Center and CeRTEV. Concerning this subject the Superintendent of Paula Souza Center, Prof. Laura Laganá, strongly advised us to make our choice based not on “political wishes”, but to analyze which city has already a Paula Souza Center with some laboratory infrastructure, and also an appropriate demand from the glass industry, which could guarantee the success of the course based on the employability of the graduates.

# **Group b:**

**ACIEPE:**

CeRTEV offered during the past four semesters, an UFSCar/ACIEPE (Atividades Curriculares de Integração de Ensino, Pesquisa e Extensão, - activities for the integration of education, research and extension) event spearheaded by the UFSCar´s Rectorate. As pointed out in our previous reports, in this activity, undergraduate students from UFSCar, under the supervision of a CeRTEV member and UFSCar faculty (Prof. Marcello Andreeta), have access to a public elementary school, in which they present and discuss some topics in basic science. In a second step, those elementary school students, aged 9-12 years, visit the Laboratório de Materiais Vítreos, LaMaV/DEMa/UFSCar, one of the main CeRTEV´s laboratories. CeRTEV´s ACIEPE is entitled “Engineers and Scientists of the Future”.

The motivation for this activity comes from the well-documented fact that the fields of exact science and engineering experience difficulties in attracting new talented students. In Europe and also in the United States of America, many efforts with heavy economic investments have been made to modify the teaching methodology to remedy this situation, with unsatisfactory results thus far. The educational literature also reports that students above an average of 14 years tend to not show any interest in the fields of science and engineering and that effort to change their mind at that particular stage produces poor results. Thus, the importance to reach younger students aged 9-12 years.

During the last year 182 elementary school students, 29 undergraduate students from UFSCar and 6 elementary school teachers participated in this project. Tests applied to elementary school students showed that after the ACIEPE activities, at least 70-80% of the students are able to understand the basic idea and properly apply the scientific method

**“Comics”**

The first volume of our “Mangá” (Comics) “Histories of glass” is ready, and has been given an ISSN number (ISSN 2359-6791). 2,000 copies were printed and were distributed during the SBPC (Sociedade Brasileira para o Progresso da Ciência - Brazilian Society for the Progress of Science) meeting held in São Carlos in July 12-18 2015. In this first volume, it is described, with simple and accessible words, “what is a glass” and why is it interesting to study glass. A second and third volume are already planned, about “glass recycling” and “optical fibers”

Our educational activities also include the development of educational kits, participation in science fairs, design of visually attractive display banners, as well as theater presentations (“science on stage”).

**Other activities:**

**Advanced School on Glasses and Glass-Ceramics**

CeRTEV organized the “Advanced School on Glasses and Glass-Ceramics”, held in São Carlos in August 1-9, 2015. This project, supported by FAPESP, selected 100 top-quality Masters and PhD students (35 Brazilians, and 65 foreigners from all over the world), with excellent CVs, who are currently doing research in the area of glasses and glass-ceramics.

# 5- List of additional funding sources except from FAPESP[[2]](#footnote-3)-

June 2013–July 2015

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Funding Agency / University / Other**  | **Equipment costs (“capital”)** | **Other direct costs (“custeio”)** | **Salaries (R$)**  | **Scholarship** | **Total** |
|
| **UFSCar** |   |   | 2.622.051,00 |   |   |
| **FAI -UFSCar** |   |   | 85.117,00 |   |   |
| **USP** |   |  500.000,00  | 2.758.890,00 |   |   |
| **UNESP** |   |   | 264.000,00 | 48.000,00 |   |
| **CAPES** |   | 70.000,00 |   | 918.400,00 |   |
| **CNPq** | 23.800,00 | 318.000,00 |   | 568.800,00 |   |
| **DFG** |   | 167.200,00 |   | 780.000,00 |   |
| **TWAS** |   |   |   | 26.400,00 |   |
| **NipponSheet Glass** |   | 16.500,00 |   |   |   |
| **Nippon Electric Glass** |   | 320.000,00 |   |   |   |
| **Humboldt** |   | 29.020,00 |   |   |   |
| **CTA** |   | 200.000,00 |   |   |   |
| **Total 1** |   | **1.620.720,00** | **5.730.058,00** | **2.341.600,00** | **9.692.378,00** |
|  |  |  |  |  |  |
| **FAPESP extra of CePID\*** |   | 459.500,00 |   | 464.268,00 |   |
| **Total 2** |   | **2.080.220,00** |  **5.715.658,00**  | **2.805.868,00** | **10.601.746,00** |

 **CEPID: R$ 8.000.000,00**

**Total with CEPID: R$ 18.601.746,00**

**ACRONYMS:**

|  |  |  |
| --- | --- | --- |
| **UFSCar** | Universidade Federal de São Carlos | Federal University of São Carlos |
| **FAI-UFScar** | Fundação de Apoio Institucional ao Desenvolvimento Científico e Tecnológico | Foundation for Institutional Support of Scientific and Technological Development - UFSCar |
| **USP**  | Universidade de São Paulo | University of São Paulo |
| **UNESP** | Universidade Estadual Paulista  | University of the State of São Paulo |
| **CAPES** | Coordenação de Aperfeiçoamento de Pessoal de Nível Superior | Coordination of Superior Level Staff Improvement |
| **CNPq** | Conselho Nacional de Desenvolvimento Cientifico e Tecnológico | National Council for Scientific and Technological Development  |
| **DFG** | Deutsche Forschungsgemeinschaft Sociedade Alemã de Amparo à Pesquisa  | German Research Foundation |
| **TWAS** |  | The World Academy of Sciences |
| **Humboldt**  |  | Alexander von Humboldt Foundation |
| **CTA** | Centro Técnico Aeroespacial | Aerospace Technical Center |

 The above numbers demonstrate that so far the CerTEV team has been capable of raising approximately one and a half times the amount directly invested by Fapesp in the CeRTEV.

A.C.M. Rodrigues, E.B. Ferreira, H. Eckert and E.D. Zanotto

August 31- 2015

# 6- Publications / citations URL[[3]](#footnote-4)

MyResearcherID: <http://www.researcherid.com/rid/J-6817-2015>

Researcher ID:**J-6817-2015**

Google Scholar: [http://scholar.google.com.br/citations?user=AG2Y4LsAAAAJ](http://scholar.google.com.br/citations?user=AG2Y4LsAAAAJ&hl=pt-BR)

1. Sumário executivo das atividades realizadas nos dois anos de vigência do CEPID (Máximo de 4 páginas, com margens de 2,5 cm, texto em espaço 1,5 fonte Times New Roman 11 ou equivalente) [↑](#footnote-ref-2)
2. Lista de outros financiamentos obtidos, ligados aos objetivos do Centro, obtidos pelos Pesquisadores Principais de outras fontes além da FAPESP (não esquecer os salários de pessoal e técnicos, e outros custos pagos pelas universidades). Preencher na tabela abaixo. [↑](#footnote-ref-3)
3. URL de uma página das publicações do CEPID no My Researcher ID e outra no Google Scholar, cada uma coma lista de publicações resultantes de pesquisas realizadas no Centro (veja um exemplo do ResearcherID em:

http://www.researcherid.com/ProfileView.action?SID=1CYYJzOYZ7l9I4VCrj3&returnCode=ROUTER.Success&queryString=KG0UuZjN5WkowGyBleN8JFp2EKKkzZIDtfLFiuMPNG8%3D&SrcApp=CR&eSID=2Foqzdese6jtU4Z58jW&Init=Yes

 Cada uma das páginas deve conter todas as publicações (ambas as ferramentas incluem automaticamente as citações das publicações). O CEPID deve criar duas páginas, uma com cada ferramenta, a seu critério e informar ambas as URLs. [↑](#footnote-ref-4)