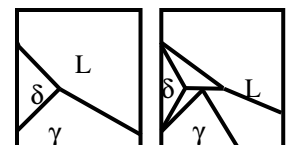
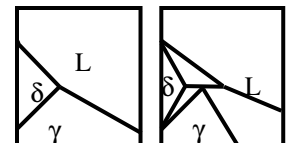

Report of the Brazilian Committee for Phase Diagrams of Materials

2005 APDIC Meeting
Maastrich, Netherlands
May 2005



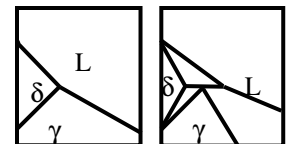
Highlights

- **Phase Diagram Seminars in 2004 and (*soon in*) 2005 ABM Conference**
- **Approval of TECOMAT Project by CNPq (*Computational Thermodynamics Applied to Advanced Materials*)**
- **Preparation for the 2006 APDIC Round Robin Seminar (Argentina-Brazil) in Rio- July 2006**
- **Contacts with INMETRO-Brasil concerning material databases**



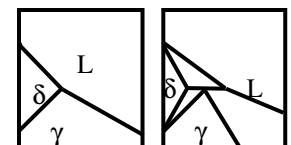
ABM Conferences 2004 and 2005

- Organizing of the *Phase Diagram Seminar* in the 59th International ABM Conference, Rio de Janeiro, July 2004.
- Organizing of the *Phase Diagram Seminar* in the 60th International ABM Conference, Belo Horizonte, July 2005.

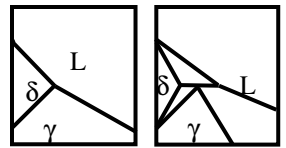
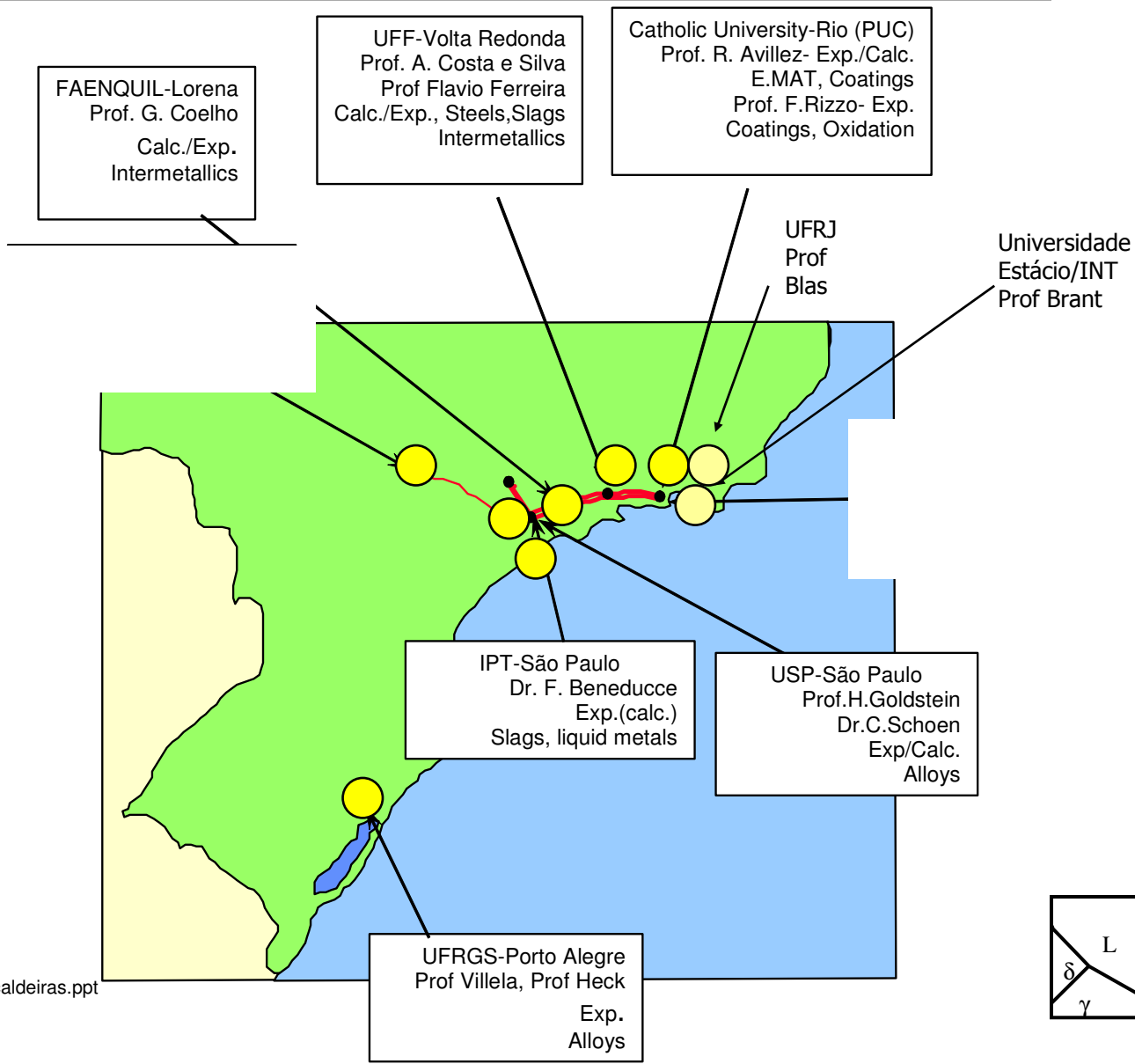


Committee Activities

- **Network project approved by CNPq focusing on Thermodynamics applied to Steel Design (result of TECOMAT 2004)**
 - Develop workshops with national specialist and funding for students to attend
 - Develop seminars for practitioners and would-be practitioners in industry
 - Sponsor and encourage graduate student exchange
 - Sponsor a program of visiting professors within Brazil
 - Project based on steel-industry colaboration
- **A 1-day “Applications of Thermodynamics” TECOMAT Seminar in 2004, sponsored by CNPq**
- **Organizing WRRS 2006**



The Committee in 2004/5 Reporting 2004/5



FAENQUIL- Lorena, SP

- **Researchers:**

Prof. Carlos A. Nunes

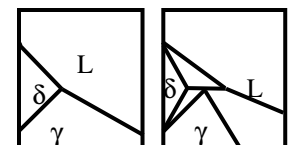
Prof. Gilberto C. Coelho

Prof Paulo Suzuki

- **Research Themes:**

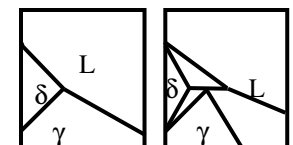
- Experimental Studies on Phase Stability in the Metal-rich Corner of the Me–Si–B Systems.
- Thermodynamic Optimization of Me–Si–B Systems.
- CALPHAD Method Applied to Materials Science.

- **Experimental: Colaborations with P Rogl and Gachon**



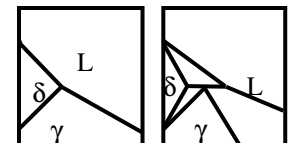
FAENQUIL- Publications

- B.B. de Lima, C.A. Nunes, G.C. Coelho, P.A. Suzuki, P. Rogl.** *Evaluation of the invariant reactions of the V–B system.* Journal of Phase Equilibria and Diffusion, 25(2), 134-139, 2004.
- C.A. Nunes, B.B. de Lima, G.C. Coelho, P. Rogl, P.A. Suzuki.** *On the stability of the V_5B_6 -phase.* Journal of Alloys and Compounds, 370(1-2), 164-168, 2004.
- A.S. Ramos, C.A. Nunes, G. Rodrigues, P.A. Suzuki, G.C. Coelho, A. Grytsiv, P. Rogl.** *Ti_6Si_2B , a new ternary phase in the Ti–Si–B system.* Intermetallics, 12(5), 487-491, 2004.
- G. Rodrigues, C.A. Nunes, P.A. Suzuki, G.C. Coelho.** *Lattice parameters and thermal expansion of the T_2 -phase of the Nb–Si–B system investigated by high-temperature X-ray diffraction.* Intermetallics, 12(2), 181-188, 2004.
- E.C.T. Ramos, C.A. Nunes, G.C. Coelho, A.S. Ramos.** *Synthesis of Ta_3Si , Ta_2Si , Ta_5Si_3 and $TaSi_2$ by mechanical alloying.* Journal of Metastable and Nanocrystalline Materials, 20-21, 201-206, 2004.
- D.M. Silvério, E.C.T. Ramos, G. Silva, A.S. Ramos, K.R. Cardoso, C.A. Nunes.** *Phase transformations during the preparation of Ti_6Si_2B by high-energy ball milling.* Journal of Metastable and Nanocrystalline Materials, 20-21, 145-150, 2004.
- D.M. Silvério, E.C.T. Ramos, G. Silva, A.S. Ramos, K.R. Cardoso, C.A. Nunes.** *Synthesis of TiB_2 by high energy ball milling.* Journal of Metastable and Nanocrystalline Materials, 20-21, 139-144, 2004.
- G.C. Coelho, J. Golczewski, H. Fischmeister.** *Thermodynamic calculations for Nb-containing high-speed steels and white cast iron alloys.* Metallurgical and Materials Transactions A, 34A(09), 1749-1758, 2003.
- L.A. Borges Junior, G.C. Coelho, C.A. Nunes, P.A. Suzuki.** *New data on phase equilibria in the Nb-rich region of the Nb–B system.* Journal of Phase Equilibria, 24(2), 140-146, 2003.



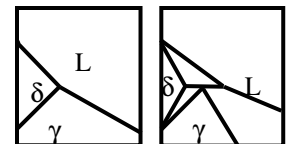
FAENQUIL- Publications

- D.M. Pinto Junior, C.A. Nunes, G.C. Coelho, F. Ferreira. *Liquidus projection of the Nb–B–Si system in the Nb-rich region*. Intermetallics, 11(3), 251-255, 2003 .
- V.A.R. Henriques, H.R.Z. Sandim, G.C. Coelho, C.R.M. da Silva. *Microstructural Evolution during Hot-Pressing of the Blended Elemental Ti–6%Al–7%Nb*. Materials Science and Engineering A, 347(1-2), 315-324, 2003.
- E.C.T. Ramos, G. Silva, A.S. Ramos, C.A. Nunes, C.A.R.P. Baptista. *Microstructure and oxidation behavior of Ti–Si–B alloys*. Materials Science and Engineering A, 363(1-2), 297-306, 2003.
- P.B. Fernandes, F. Ferreira, G.C. Coelho, C.A. Nunes, B. Sundman. *Thermodynamic modeling of the Nb–Si system*. Intermetallics, 10(10), 993-999, 2002.
- K.C.G. Candioto, C.A. Nunes, G.C. Coelho, P.A. Suzuki. *Microstructural Characterization of Nb–B–Si alloys with composition in the Nb–Nb₅Si₂B (T₂-Phase) vertical section*. Materials Characterization, 47(3-4), 241-245, 2001.
- C.A. Nunes, G.C. Coelho, A.S. Ramos. *On the invariant reactions in the Mo-rich side of the Mo–Si System*. Journal of Phase Equilibria, 22(5), 556-559, 2001.
- C. A. Nunes, R. Sakidja, Z. Dong and J. H. Perepezko. *Liquidus projection for the Mo-rich portion of the Mo–Si–B ternary system*. Intermetallics, 8(4), 327-337, 2000.
- C.A. Nunes, G.C. Coelho, D.M. Pinto Junior, K.C.C. Gandolpho, L.A. Borges Junior, G. Rodrigues. *Phase stability in the Nb-rich region of the Nb–B–Si system*. Intermetallics and Superalloys EUROMAT – vol 10, 317-323, WILEY–VCH Verlag GmbH, ISBN 3-527-30192-5, 2000.
- C.A. Nunes, R. Sakidja, J.H. Perepezko. In: M.V. Nathal, R. Darolia, C.T. Liu, P.L. Martin, D.B. Miracle, R. Wagner, M. Yamaguchi, editors. Structural Intermetallics 1997. Warrendale (PA): TMS, 831–839, 1997



IPD-CTEx Rio de Janeiro RJ

- **Research Staff**
 - P Cosentino
- **Research Topics**
 - High temperature low density borides
 - Sintering of borides
 - Synthesis of borides



IPT - São Paulo SP

Research staff:

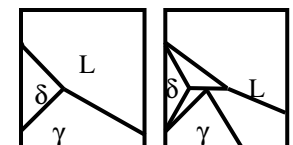
Flávio Beneduce Neto

Research areas:

Pyrometallurgical processing of metals. Process development.

Main activities:

- Producing MgO-Al₂O₃-SiO₂ samples (silica rich corner) to get information for optimization of the system that has been carried out by UFF and MPI – samples produced do have two phases;
- Producing TiO₂-FeO samples to carry out DTA experiments in order to re-evaluate the liquidus line. The samples were characterized by R-X diffraction and by EDS in SEM;
- Optimizations of the systems MgO-TiO₂, FeO-TiO₂ and Al₂O₃-TiO₂ using the IRSID model (IPT-UFF-PUC-Rio)



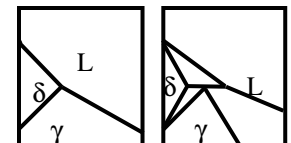
UFRGS – Porto Alegre RS

Steelmaking Group

- **Research Staff:**
 - Prof. Dr. Antônio Cezar Faria Vilela
 - Prof. Dr. Carlos Alberto Mendes Moraes
- **Research Themes:**
 - Reutilization of stainless Steelmaking slag – thermodynamic Modelling of metal/slag reactions via FACTSAGE software
 - Inclusion modeling of Steelmaking process – thermodynamic modeling of metal/slag/inclusion reactions via FACTSAGE software.

Metallurgy Dept.

- **Research Staff**
 - Prof. Nestor Cezar Heck, Dr.-Ing.
- **Research Areas:**
 - - Phase diagram applications in nitriding / carbonitriding / carburizing of steel.



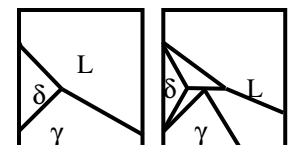
UFRGS- Publications

BIELEFELDT, Wagner V; MORAES, Carlos Alberto Mendes; VILELA, A. C. F.; FERNANDES, Paulo Carvalho; KLUJSZO, Luis Augusto Colembergue. EVOLUÇÃO DAS INCLUSÕES NO PROCESSAMENTO DO AÇO SAE 8620 VIA ACIARIA ELÉTRICA. In: **59º CONGRESSO ANUAL DA ABM - INTERNACIONAL, 2004, São Paulo. 2004**

BIELEFELDT, Wagner V; MORAES, Carlos Alberto Mendes; VILELA, A. C. F.; ESTUDO DE INCLUSÕES NO TRATAMENTO COM CÁLCIO UTILIZANDO TERMODINÂMICA COMPUTACIONAL. In: **60º CONGRESSO ANUAL DA ABM - INTERNACIONAL, 2005, Belo Horizonte. 2005**

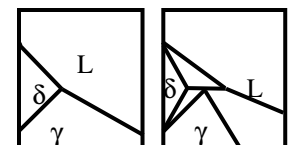
Heck, N.C.; Tentardini, E.K.; Strohaecker, T.R. "Estudo da estabilidade de filmes finos para o revestimento de ferramentas para injeção de alumínio" In: **60º CONGRESSO ANUAL DA ABM - INTERNACIONAL, 2005, Belo Horizonte. 2005**

Heck, N.C.; Vilela, A.C.F. "Análise termodinâmica computacional da produção de aço inoxidável – fundamentos" In: **60º CONGRESSO ANUAL DA ABM - INTERNACIONAL, 2005, Belo Horizonte. 2005**



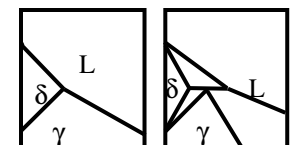
UFF – Volta Redonda RJ

- **Research staff:**
 - Prof. André Luiz V. da Costa e Silva
 - Prof Flavio Ferreira
- **Research areas:**
 - Steelmaking process modeling: refractory –slag - metal interactions.
 - Non-metallic inclusion formation in steel.
 - Microstructural evolution in steels.
 - Galvanizing and other zinc coating processes.
- **Highlights**
 - Approval of TECOMAT Project
 - New Physical-Chemistry undergraduate course using Computational Thermodynamics



UFF- Some Publications

- PIRES, J. C. S. ; COSTA E SILVA, A. ; GARCIA, A. .** Comparação entre resultados de análise térmica diferencial e simulação via termodinâmica computacional em escórias coletadas em uma planta industrial. In: **XXXVI Seminário de Fusão Refino e Solidificação dos Metais- Internacional, 2005, Vitória, ES. Anais do XXXVI Seminário de Fusão Refino e Solidificação dos Metais- Internacional. São Paulo, SP : ABM, 2005. p. 399-407.**
- COSTA E SILVA, A. .** Aplicações da termodinâmica computacional a aciaria. In: **XXXVI Seminário de Fusão Refino e Solidificação dos Metais- Internacional, 2005, Vitória, ES. Anais do XXXVI Seminário de Fusão Refino e Solidificação dos Metais- Internacional. São Paulo SP : ABM, 2005. p. 386-398.**
- PASSOS, S. R. M. ; SERRA, J. G. ; SUZAKI, K. ; NOVAIS, E. A. ; COSTA E SILVA, A. .** Modelo estatístico para avaliação da limpeza interna e a influência do TiN na remoção das inclusões não-metálicas dos aços de alta resistência da CSN. In: **XXXV Seminário de Fusão Refino e Solidificação dos Metais, 2004, Salvador. a ser publicado nos Anais do XXXV COACO Maio 2004. São Paulo : ABM, 2004.**
- COSTA E SILVA, A. ; AVILLETZ, R. R. .** Uma avaliação preliminar da região rica em Fe do sistema Fe-Nb-P e suas implicações sobre o processamento de aços IF. In: **59 Congresso Anual da ABM- Internacional, 2004, São Paulo. Anais do 59 Congresso Anual da ABM- Internacional [CDROM]. São Paulo : Associação Brasileira de Metalurgia e Materiais, 2004. p. 1-10.**
- AVILLETZ, R. R. ; MARINKOVIC, B. ; COSTA E SILVA, A. ; Rizzo, F. .** Cinética de precipitação de carbonetos em um aço 2,25Cr-1Mo. In: **59 Congresso Anual da ABM- Internacional, 2004, São Paulo. Anais do 59 Congresso Anual da ABM- Internacional. São Paulo : Associação Brasileira de Metalurgia e Materiais, 2004. p. 1-10.**
- BENEDUCE, F ; COSTA E SILVA, A. ; AVILLETZ, R. R. .** Análise termodinâmica de sistemas contendo óxidos de titânio visando o controle de inclusões não-metálicas em aços. In: **59 Congresso Anual da ABM- Internacional, 2004, São Paulo. Anais do 59 Congresso Anual da ABM- Internacional [CDROM]. São Paulo : Associação Brasileira de Metalurgia e Materiais, 2004. p. 1-10.**



UFF- Some publications

COSTA E SILVA, A. ; AVILLETZ, Roberto Ribeiro de ; BENEDEUCE, F . A preliminary evaluation of selected TiO₂ containing oxide systems with applications in slag-steel-inclusion equilibria. **In: CALPHAD XXXIII - Calculation of Phase Diagram and its Applications, 2004, Krakow. Calphad XXXIII- Program and Abstracts. Krakow, Polonia : Institute of Metallurgy and Materials Science, Polish Academy of Sciences, 2004. p. 99.**

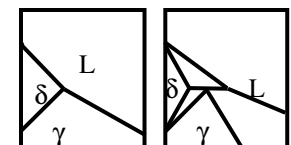
AVILLETZ, Roberto Ribeiro de ; COSTA E SILVA, A. . A preliminary evaluation of the Fe rich region of the Fe-Nb-P system and its implications on the Processing of IF (Interstitial Free) steels. **In: CALPHAD XXXIII - Calculation of Phase Diagram and its Applications, 2004, Krakow. CALPHAD XXXIII- Program and Abstracts. Krakow, Polonia : Institute of Metallurgy and Materials Science, Polish Academy of Sciences, 2004. p. 107.**

COSTA E SILVA, A. ; RIZZO, F ; SPEER, J G . A Study of the Partition of Elements between Austenite and Ferrite in Conditions similar to the Treatment of TRIP Steels. **In: CALPHAD XXXIII - Calculation of Phase Diagram and its Applications, 2004, Krakow. CALPHAD XXXIII- Program and Abstracts. Krakow, Polonia : Institute of Metallurgy and Materials Science, Polish Academy of Sciences, 2004. p. 127.**

COSTA E SILVA, A. ; AVILLETZ, R. R. . Um banco de dados termodinâmicos para aços IF (Interstitial Free). **Revista Tecnologia Em Metalurgia e Materiais, São Paulo, v. 1, n. 1, p. 64-68, 2004.**

AVILLETZ, R. R. ; COSTA E SILVA, A. ; ROCHA, A. C. . Efeito das adições de Ti, Nb e S sobre a decomposição da austenita e a precipitação em aços IF (interstitial free). **Revista Tecnologia Em Metalurgia e Materiais, São Paulo, v. 1, n. 1, p. 39-43, 2004.**

FABRICHNAYA, O ; COSTA E SILVA, A. ; ALDINGER, F . Assesment of thermodynamic functions in the MgO-Al₂O₃-SiO₂ system. **Zeitschrift fur Metallkunde, Munchen, Germany, v. 95, n. 9, p. 793-805, 2004.**

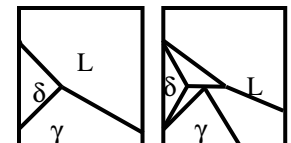


PUC-Rio de Janeiro RJ

- **Research staff:**
 - Prof. Fernando Cosme Rizzo Assunção
 - Prof. Roberto Ribeiro de Avillez
- **Research areas:**
 - Galvanizing and other zinc coating processes.
 - High temperature corrosion.
 - Microstructural evolution in steels.
 - Semiconductor deposition by elemental evaporation.
 - Nodular iron casting.
- **Highlights**

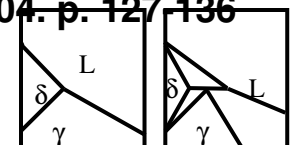
Prof Rizzo in Leeds in 2004

Prof Avillez coordinates TECOMAT project



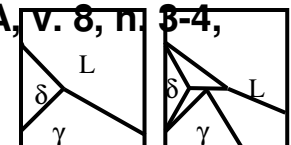
PUC-Rio Some Publications

- ASSUNCAO, F. C. R. ; FARIA, M. I. S. T. ; PACIORNIK, S. ; WROBLEWSKI, T. .** Phase Transformations in the Fe-Zn System - analysis by the MAXIM Technique. In: **Galvatech 2004, 2004, Chicago. Galvatech 04 Conference Proceedings, 2004. v. 01. p. 675-682.**
- MONTEIRO, M. J. ; ASSUNCAO, F. C. R. .** Oxidação de Aços Rápidos com Variação de Vanádio. In: **59º Congresso Anual da ABM - Internacional, 2004, São Paulo. Anais do 59º Congresso Anual da ABM. São Paulo : Tec Art Editora Ltda, 2004. p. 789-797.**
- AVILLENZ, R. R. ; MARINKOVIC, B. ; SILVA, A. C. E. ; ASSUNCAO, F. C. R. .** Cinética de precipitação de carbonetos em um aço 2,25Cr-1Mo. In: **59º Congresso Anual da ABM - Internacional, 2004, São Paulo. Anais do 59º Congresso Anual da ABM. São Paulo : Tec Art Editora Ltda, 2004. p. 940-946.**
- POLASEK, A. ; SALÉH, L. A. ; BORGES, H. ; MARINKOVIC, B. ; ASSUNCAO, F. C. R. ; SERRA, E. T. ; OLIVEIRA, G. S. .** Production of High Temperature Superconductors for Fault Current Limiters. In: **59º Congresso Anual da ABM - Internacional, 2004, São Paulo. Anais do 59º Congresso Anual da ABMq. São Paulo : Tec Art Editora Ltda, 2004. p. 1732-1738.**
- SPEER, J. G. ; ASSUNCAO, F. C. R. ; MATLOCK, D. K. ; EDMONDS, D. V. .** The Quenching and Partitioning Process: Background and recent progress. In: **59º Congresso Anual da ABM - Internacional, 2004, São Paulo. Anais do 59º Congresso Anual da ABM. São Paulo : Tec Art Editora Ltda, 2004. p. 4824-4836.**
- POLASEK, A. ; SALÉH, L. A. ; BORGES, H. ; HERING, E. N. ; OLIVEIRA, G. S. ; SERRA, E. T. ; LIMA, J. H. G. ; ASSUNCAO, F. C. R. .** Investigation of Pb-free Bi-2223 High Temperature Sintering. In: **Applied Superconductivity Conference (ASC 2004), 2004, Jacksonville, 2004.**
- MONTEIRO, M. J. ; ASSUNCAO, F. C. R. .** Oxidação de Aços Rápidos para Fabricação de Cilindros de Laminação a Quente. In: **41º Seminário de Laminação, Processos e Produtos Laminados e Revestidos, 2004, Joinville. Anais do 41º Seminário de Laminação, Processos e Produtos Laminados e Revestidos. São Paulo : Édile - Serviços Gráficos e Editora Ltda, 2004. p. 127-136**



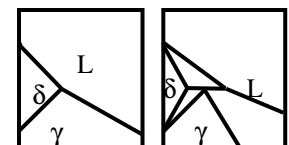
PUC-Rio Some Publications

- ASSUNCAO, F. C. R. ; CAMINHA, I. M. V. ; ZENG, C. ; PAES, M. P. ; MONTEIRO, M. J. .** Corrosion Resistance of a Steel Under an Oxidizing Atmosphere in a Fluid Catalytic Cracking Regenerator. **Materials Research, São Paulo, v. 7, n. 1, p. 183-188, 2004.**
- ASSUNCAO, F. C. R. ; ROCHA, A. C. ; ZENG, C. ; PAES, M. P. .** Duplex Al-Based Thermal Spray Coatings for Corrosion Protection in High Temperature Refinery Applications. **Materials Research, São Paulo, v. 7, n. 1, p. 189-194, 2004.**
- POLASEK, A. ; MAJEWSKI, P. ; SERRA, E. T. ; ASSUNCAO, F. C. R. ; ALDINGER, F. .** Phase Relations Study on the Melting and Crystallization Regions of the Bi-2223 High Temperature Superconductor. **Materials Research, São Paulo, v. 7, n. 3, p. 393-408, 2004.**
- XIA, S. ; POLASEK, A. ; SALÉH, L. A. ; MARINKOVIC, B. ; ASSUNCAO, F. C. R. ; SERRA, E. T. .** Preparation of Bi-2223/Ag Tapes by the Partial Melting Route. **Physica C - Superconductivity, v. 408, n. 410, p. 911-912, 2004.**
- MARINKOVIC, B. ; XIA, S. ; SERRA, E. T. ; BORGES, H. ; HERING, E. N. ; ASSUNCAO, F. C. R. .** Electrical current suppression mechanism in Bi-2212 bulk obtained by partial melting processing. **Physica C - Superconductivity, v. 408, n. 410, p. 34-36, 2004.**
- JARDIM, P. M. ; MARINKOVIC, B. ; SAAVEDRA, A. ; LAU, L. Y. ; BAHTZ, C. ; ASSUNCAO, F. C. R. .** A Comparison Between Thermal Expansion Properties of Hydrated and Dehydrated Orthorhombic HZSM-5 Zeolite. **Microporous And Mesoporous Materials, v. 76, p. 23-28, 2004.**
- POLASEK, A. ; MAJEWSKI, P. ; SERRA, E. T. ; ASSUNCAO, F. C. R. .** Insights into the phase relationships involved in the Bi-2223 melting and crystallization regions. **Physica C - Superconductivity, v. 408, n. 410, p. 860-861, 2004.**
- SPEER, J. G. ; EDMONDS, D. V. ; ASSUNCAO, F. C. R. ; MATLOCK, D. K. .** Partitioning of Carbon from supersaturated plates of ferrite, with application to steel processing and fundamentals of the bainite transformation. **Current Opinion In Solid State And Materials Science, USA, v. 8, n. 3-4, p. 219-237, 2004.**



USP – São Paulo SP

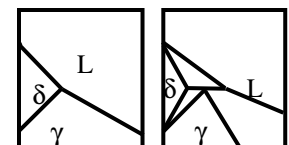
- **Research staff:**
 - Prof Helio Goldenstein
 - Prof. Dr. Cláudio G. Schön
- **Main activities:**
- **Helio Goldstein**
 - *Studies in the Al-C-Cr-Fe-Ni system. New experimental data information from DTA, WDS, SEM and XRD are being acquired. New parameters to describe carbon solubility on matrix phases (NiAl-b, NiAl-g and Ni₃Al-g' are being developed.*
 - *Assessment of Sm-Co and Co-Y systems to include new experimental data for magnetic transformations and invariables equilibriums. This assessment is done in cooperation with UFF.*
 - *Evaluation of diluted databases for Ni, Co and Cu based solutions (Wagner model data adapted to Darken quadratic formalism. (*
- **Claudio Schon**
 - *CVM modelling of metals and intermetallic compounds*
 - *Modelling of the BCC Co-Cr-Al , Ti-Al systems*
 - *C-Cr-Mo-Fe system by standard CALPHAD methods*
 - *Revision of the **cvm17bf** program*



USP Publications- Highlights

FARINA, Alexandre Bellegard; GOLDENSTEIN, Hélio; SILVA, Yuri Nunes da; SILVA, Wanderson Santana da. PROGRESSOS NO DESENVOLVIMENTO DO BANCO DE DADOS TERMODINÂMICOS PARA O SISTEMA Ni-Cr-Al-C. In: **59º CONGRESSO ANUAL DA ASSOCIAÇÃO BRASILEIRA DE METALURGIA E MATERIAIS, 2004, São Paulo. 59º Congresso Anual da Associação Brasileira de Metalurgia e Materiais. Associação Brasileira de Metalurgia e Materiais, 2004. v. 59, p. 999-1010.**

FARINA, Alexandre Bellegard; BENEDUCE NETO, Flávio; GOLDENSTEIN, Hélio; SILVA, Wanderson Santana da; SILVA, Yuri Nunes da. PROGRESS ON DEVELOPMENT OF THE THERMODYNAMIC DATABASE OF THE SYSTEM Ni-Cr-Al-C. In: **Gordon Research Conference on High Temperature Materials, Processes and Diagnostics. Colby College, Waterville, Maine. August 1-6, 2004.**



2006 WRRSeminar

- **Where: Rio de Janeiro**
- **When:**
 - July 2006
- **First day of the 2006 International ABM Conference**
- **Program**
 - Emphasis on applications

