

Application of the Brazilian Vacuum Society for an IUVSTA Technical Training Course (TTC) Grant

National Vacuum Society: Brazilian Vacuum Society (Sociedade Brasileira de Vácuo)

Course Title: Vacuum, Plasma, Surfaces, and Thin Films

Location: Sorocaba, SP, Brazil

Date of TTC: August 08th-12th, 2022 (36 hours)

Part of a conference: XLIII Brazilian Congress of Vacuum Applications in Industry and Science (CBrAVIC)

Object of the TCC:

- Learn the fundamental physics and chemistry of vacuum, plasma, surfaces, and thin films;
- Learn the various physical and chemical processes;
- Make and to learn the practice process of plasma surface treatment and to characterize the material with surface treatment;
- Learn the principal surface analysis techniques;
- Know some of the most important applications; Practical class on instrumentation.

Languages: Portuguese and English

This IUVSTA Technical Training Course will be offered mainly in Portuguese, with two modules in English, in conjunction with the XXXIX Brazilian Congress of Vacuum Applications in Industry and Science, which will be held in Sorocaba, Sao Paulo state, Brazil, on August 08th-12th, 2022. This TCC constitutes of seven modules:

- Introduction to Vacuum Science and Technology;
- Plasma Surface Treatments: Theory;
- Plasma Surface Treatment: Practice
- Thin Films and Coatings: Deposition Methods and Surface Characterization;
- Vacuum Metrology.
- Vacuum Calculations: Theory and Practice.

- Rarefied Gas Dynamics: Theory and Vacuum Applications.

Lecturers:

Francisco T. Degasperi, Paula Souza State Center for Technological Education (CEETEPS), Sao Paulo, SP, Brazil;

Marcelo J. Ferreira, European Spallation Source (ESS), Lunden, Sweden;

Rodrigo S. Pessoa, Technological Institute of Aeronautics (ITA), Department of Physics, Sao Jose dos Campos, SP, Brazil;

Milton E. Kayama, State University of Sao Paulo (UNESP), Guaratingueta, SP, Brazil;

Konstantin G. Kostov, State University of Sao Paulo (UNESP), Guaratingueta, SP;

Luciana S. Rossino, Paula Souza State Center for Technological Education (CEETEPS), Sorocaba, SP, Brazil;

Marcos D. Manfrinato, Paula Souza State Center for Technological Education (CEETEPS), Sorocaba, SP, Brazil;

Nazir M. Santos, Paula Souza State Center for Technological Education (CEETEPS), Itaquera, Sao Paulo, SP, Brazil;

Conrado R. M. Afonso, Federal University of Sao Carlos (UFSCar), Department of Materials Engineering (DEMa), Sao Carlos, SP, Brazil;

Angelo L. Gobbi, Brazilian Center for Research in Energy and Materials (CNPEM), Brazilian Nanotechnology National Laboratory (LNNano), Microfabrication Laboratory (LMF), Campinas, SP, Brazil;

Pedro A. P. Nascente, Federal University of Sao Carlos (UFSCar), Department of Materials Engineering (DEMa), Sao Carlos, SP, Brazil;

Matthias Bernien, Physikalisch-Technische Bundesanstalt (PTB), Berlin, Germany;

Roberto Kersevan, Organisation Européenne pour la Recherche Nucléaire (CERN), Technology Department, Geneve, Swiss;

Felix Sharipov, Federal University of Paraná (UFP), Curitiba, PR, Brazil.

Course Outline:

1. Introduction to Vacuum Science and Technology (8 hours, in Portuguese)

Lecturers: Francisco Tadeu Degasperi, Fatec São Paulo/CEETEPS, Sao Paulo, SP, Brazil and Marcelo J. Ferreira, European Spallation Source (ERIC-Suécia).

- Gases and vapors;
- Kinetic theory of gases;
- Gas flow regimes;
- Conductance, flow, and pumping speed;
- Vacuum pumps, vacuum meters;
- Materials, cleaning techniques, and conditioning;
- Vacuum systems for general use;
- Specification of vacuum systems;
- Residual gas analysis;
- Controlled injection of gases and vapors;
- Leak detection;
- Case studies in vacuum technology.

2. Plasma Surface Treatments – Theory (8 hours, in Portuguese)

Lecturers: Rodrigo S. Pessoa, ITA, Sao Jose dos Campos, SP, Brazil; Dr. Milton E. Kayama, UNESP, Guaratingueta, SP, Brazil, and Konstantin G. Kostov, UNESP,1 Guaratingueta, SP, Brazil.

- Definition and characteristics of plasma;
- Process parameters (pressure, flux power, etc);
- Reactive species at the plasma;
- Plasma-surface interactions;
- Surface reactions;
- Plasma techniques for surface treatments – characteristics and applications;
- Treatment characterization;
- Evolution of plasma surface treatments.

3. Plasma Surface Treatments – Practice (12 hours, in Portuguese)

Lecturers: Luciana S. Rossino, CEETEPS, Sorocaba, SP, Brazil, and Marcos D. Manfrinato, CEETEPS, Sorocaba, SP, Brazil.

- Material surface preparation;
- Plasma surface treatment;
- Metallography surface preparation;
- Metallography analysis;

- Hardness surface analysis;
- Compilation of data for paper writing.

4. Thin Films and Coatings: Deposition Methods and Surface Characterization (12 hours, in Portuguese)

Lecturers: Nazir M. Santos, CEETEPS, Itaquera, Sao Paulo, SP, Brazil, Conrado R. M. Afonso, UFSCar/DEMa, Sao Carlos, SP, Brazil, Angelo L. Gobbi, CNPEM/LNNano, Campinas, SP, and Pedro A. P. Nascente, UFSCar/DEMa, Sao Carlos, SP, Brazil.

- Introduction;
- Vacuum – definitions and uses;
- Plasmas – definitions and uses;
- Substrate cleaning;
- Deposition methods: CVD, ALD, thermal evaporation, sputtering, e-beam, MBE, electrodeposition;
- Microstructural analyses: SEM, TEM, EDS, and WDS;
- Surface characterization techniques: XPS and AES;
- Applications: modified surfaces, thin films, and coatings.

5. Vacuum Metrology (4 hours, in English)

Lecturer: Matthias Bernien, PTB, Berlin, Germany.

- Introduction;
- Vacuum metrology – physical principles;
- Vacuum metrology – instrumentation;
- Importance to science and to technology of metrology;
- State equations of gases to vacuum metrology;
- Types of methods to vacuum metrology;
- Static expansion of gas method;
- State of the art in vacuum metrology.

6. Vacuum Calculations: Theory and Practice (4 hours, in English)

Lecturer: Roberto Kersevan, CERN, Geneve, Swiss.

- Introduction;
- Vacuum physics to calculations the gas transport;

- State equations of gases to vacuum calculations of the pressure in vacuum system;
- Pressure field calculation in high vacuum conditions;
- Monte Carlo method calculations;
- Molflow Software;
- Other methods to calculations in vacuum system;
- State of the art in vacuum calculations;
- Study of cases.

7. Dynamic of Rarefied Gas Dynamics: Theory and Vacuum Applications (4 hours, in Portuguese).

Lecturer: Felix Sharipov, UFP, Curitiba, PR, Brazil.

- Introduction.
- Vacuum metrology – instrumentation.
- Importance to science and to technology of metrology.
- State equations of gases to vacuum metrology.
- Types of methods to vacuum metrology.
- Static expansion of gas method.
- State of the art in vacuum metrology.

Expected job profiles and education level of the students:

Engineers, physicists, chemists, and technicians working at industries or research centers; graduate students. The prospective students should have at least undergraduate level.

Expected number of students: 60. The student can enroll in 1, 2, 3, 4, 5, 6, and/or 7 modules.

Finances:

Expected total amount of IUVST support: 2,000.00 Euros. This will partially cover for the travel expenses and accommodation for the 14 lecturers. With the IUVSTA TCC grant, fees will be waved to selected students.

Provisional Budget:

Travel costs (speakers): € 520.00;

Four nights in a hotel in Sorocaba (speakers): € 1,800.00;

Meals: € 1,260.00;

Material: € 200.00;

Coffee break for all participants: € 420.00;

Total: € 4,200.00 (€ 2,000.00 from IUVSTA and € 2,200.00 from the student fees and the Brazilian Vacuum Society).

Exchange rate in March 2022: € 1.00 = R\$ 5.59.

TITLE: Vacuum, Plasma, Surfaces, and Thin Films

VENUE: Sorocaba, Sao Paulo, Brazil

DATE: August 08th 2022 - August 12th 2022

Income	Unit cost (EUR)	Quantity	Sub-Total (EUR)	Remarks
Registration Fee (per person per module)	15.00	60	900.00	Coffee break for all participants
Brazilian Vacuum Society funding	1,300.00	1	1,300.00	Accommodation (partial) and meals for the invited lecturers
IUVSTA funding	2,000.00	1	2,000.00	Transport and accommodation (partial) for the invited lecturers
Total (EUR)			4,200.00	

Expenditures	Unit cost (EUR)	Quantity	Sub-Total (EUR)	Remarks
Airticket (Curitiba - Sao Paulo - Curitiba)	80.00	1	80.00	For Felix Sharipov
Land transport	40	11	440.00	From different cities in Sao Paulo state to Sorocaba
Accommodation (4 nights per person)	150.00	12	1,800.00	Four nights in a hotel in Sorocaba for the invited lecturers (except for Luciana and Marco)
Meals (4 days per person)	90.00	14	1,260.00	Lunch and dinner for the invited lecturers
Material	200.00	1	200.00	Material and miscellaneous
Coffee break	30.00	14	420.00	2 per day, 4 days
Total (EUR)			4,200.00	

* Exchange rate EURO/REAL ~ 5.59 (March 2022)