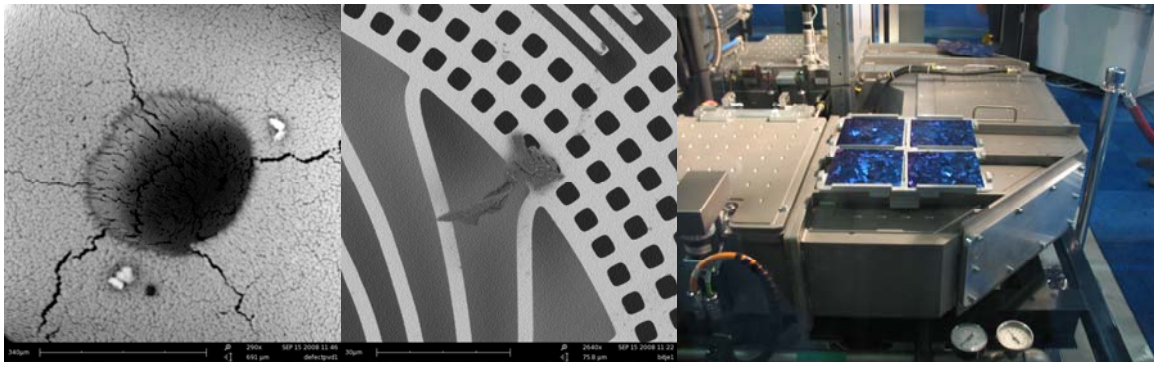
ITC-2011

International Technological Courses

by



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Introduction

In general the course materials (sheets, additional papers, and so on) are written in the English language, but there are exceptions. The courses however can be given in fluent English, German and of course the Dutch language. The courses are unique and valued by the customers of RTC&P Consultancy & Projectmanagement BV. The course are made with a variety of challenges for the participants and always open for discussions and issues the participants are dealing with.
If you are interested in courses please be that RTC&P also prepares custom made courses and the courses in these catalogue are only a few examples of the numerous courses which are given to the industry. All courses can be examined and certificates can be issued for the participants. If you are interested to follow an external course as organized by RT&P, please look for scheduled external courses at: **www.rtcenp.org**


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Overview of International Technological Courses

(planned dates at www.rtcenp.org)

Chapter 1. Contamination and contamination control	Level	Language course materials	Appr. Teach-ing Hours	Page
Introduction course contamination	L/M/H	English	8	5
Contamination in high tech processes	L/M/H	English	30	6-7
Contamination of the vacuum in high tech processes	L/M/H	English	16	8
Clean working for production facilities in the high tech industry	L/M	Dutch/English	8	9-10
Chapter 2 Precision cleaning technologies				
An overview of precision cleaning technologies	L/M/H	English	8	11
Advanced Precision cleaning technologies	L/M/H	English	24	12
Improving the quality and speed of wet chemical cleaning processes	M/H	English	8	13-14
Plasmacleaning	L/M/H	English	8	15
Chapter 3 Deposition technologies				
Vacuum & gases in deposition technology	L/M/H	English	5	16
An introduction in PVD technology	L/M/H	English	8	17
PVD Technology	M/H	English	16	18
Uniformity and quality in PVD-coatings	L/M/H	English	7	19
Deposition Technologies	L/M/H	English	8	20
Electroforming of nickel	L/M/H	English	8	21
Chapter 4 Plasmatechnology				
An overview of industrial applied plasma technology	L/M/H	English	8	22
Introduction to Plasmatechnology	L/M/H	English	8	23
Advanced course Plasmatechnology	L/M/H	English	24	24
Chapter 5 Materials and surface technology				
Surface and materials technology for mechanical engineers in the high tech industry	M/H	English	24	24
Effects of hydrogen in metals	L/M/H	English	8	25
Chapter 6 Technology Management				
Protection of confidential information in cooperation with external parties	H	English	8	25
Important sources for technological information in R&D/Technological Projects	H	English	8	25

L=Basic level M=moderate H=high

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Something about the author and course instructor

Ir. R.J.F. Theunissen

All courses are made and written by ir. Roger Theunissen (41) who founded RTC&P Consultancy & Projectmanagement B.V. in February 2000. After his chemical study at the Technical University of Eindhoven (1994), he worked at ODME as a process engineer helping international customers on site with process problems. After that he joined the Stork Prints company to realize a production process for the production of complex shaped precision components.
Without any interruption in his career, he always has been working with pleasure and pragmatically on innovating and improving industrial manufacturing processes in practice. A tremendous experience has been built up during **17 years continuously working** for the industry.
Recommended by its customers, courses are given (inter)nationally to all kinds of companies. RTC&P has trained more than 800 production people, operators, engineers, managers and managing directors.

- More detailed information about the author and course instructor is available on the website of linkedin: http://www.linkedin.com/in/rjftheunissen1
- Personal mobile phonenumber of Roger Theunissen: +31(0)-653351448 or send an e-mail to info@rtcenp.org

Intentions of courses
Teaching of the understanding of processes based on practical experience is more important than teaching technological facts. The internet is in general easy accessible for technological facts. Active involvement and working together with knowledge and sharing experience makes technology almost unforgettable to the participants. Working on relevant issues with the participants is more exciting than theory.
Courses are necessary investments in people. How can people solve technological problems, improve manufacturing processes or innovate when technology is not understood?

References
VDL Bekaert ASML Philips NV Philips Belgium Philips Germany OTB-group Scheuten Pilkington Oce VDT Bosch Group Stork Ionbond Toyota DSM NXP Aalberts Industries 3M Varian Alcatel and many more!

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Chapter 1. Introduction course contamination

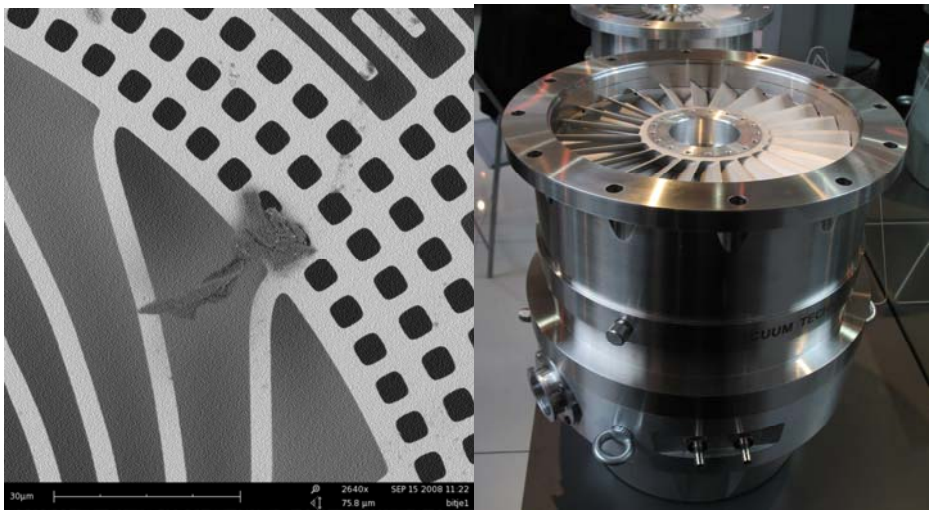
Introduction
This course is handling the basics of contamination(s) and its causes and consequences in industrial manufacturing processes. Due to increased specifications for products and (semi) manufactured parts, the manufacturing process is not only described by the process parameters but also by the parameters, circumstances and situations which should be avoided.

Content of this course
This interesting course describes the basics of contaminations and the kind of contaminations which can occur in sequential industrial manufacturing processes and cause problems. It describes conveniently the contamination processes (aging, corrosion, cross contamination and so on) based on practical experience. This course is the basis for learning about contaminations which contribute to the loss of quality and yield losses in production processes (e.g. defects) and resulting products.

Basics of contamination (explanation, level, sources, organic, inorganic, matrix and so on)
Characteristics of contaminations
Surface, material and process contamination
Processes contributing to contamination (corrosion, aging, electromigration and so on)
Effects of contamination
Practical examples of contaminations

For whom is this course interesting?
Engineers, (production)managers and technologists of all kind of departments working with contaminated or polluted base materials, (semi-manufactured) products or (parts of) machines. Highlighted are contaminations for example in vacuum and high tech processes.
This course is also interesting for surface (coating & cleaning) technologists who experience surface (coating) defects or quality and yield losses in production processes like for example:

Cleaning of parts necessary for vacuum in high tech processes
Vacuum deposition processes (PVD, CVD, ALD, and so on)
Vacuum plasma treatments
Precision cleaning
High tech deposition processes



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Chapter 1. Contamination in high tech processes

Introduction

Surfaces for vacuum and high tech applications (solar, EUV, electronics, optics and so on) have to meet increasing requirements with respect to their cleanliness. To apply the right cleaning process, the knowledge of the contaminations and the pollution on the surface is evident. Also understanding what kind of effects the cleaning method has on the surface and the material are important aspects. Further processing at a high quality and/or zero defect requires an understanding of contamination and its sources. This course is giving an overview about practical contaminations as occurring in high tech and vacuum applications. Also the effects of the contamination on the application itself as well as the possible cleaning technologies are explained. In this course also the methods for surface analysis of cleaned and contaminated surfaces are overviewed. With this course participants are able to understand the (sources of) contaminations on surfaces, the effects of contaminations, the methods to remove contaminations as well as measuring contamination.

Content of this course

This course is divided in several parts:

1. Contaminations on surfaces
2. Effects of contaminations in vacuum and high tech applications
3. Precision Cleaning Technologies, part 1
4. Precision Cleaning Technologies, part 2
5. Overview of surface analysing techniques for (contaminated and cleaned) surfaces

Contamination on surfaces

Kind of contaminations (films, particles, oxides, matrixes and so on)
Causes and sources of contaminations

Particle contamination
- Particle formation
- Sources of particles
- Particle adhesion
- Particle removal processes

Monolayers of contaminations
AMC (Airborne Moleculair Contamination)
Contamination due to surface and materials defects
Prevention of contaminations
Materials defects causing contamination (porosity, inclusions, and so on)

Coating defects causing contamination
(Induced) defects in (coated) surfaces
Packaging materials
ESD (ESD = Electro Static Discharge)
ESD-defects/damage, explanation ESD, solutions for ESD-problems

Effects of contaminations on vacuum and high tech applications

Effects of contaminations on the applications will be highlighted.

- Overview of behavior of surfaces and materials in vacuum
- Overview of effects of contaminations in relation with vacuum processes (e.g. EUV, PVD, CVD and plasma treatments)
- Effects of contaminations in high tech applications (electronics, high tech coatings and so on)
- Understanding effects of contaminations
- Effects of contamination of vacuum chambers
- Contamination in relation with defects

Precision cleaning technologies, part 1 (highlight innovative wet chemical cleaning)

In this section precision cleaning technologies are highlighted and explained. The possibilities, applications, the strengths, the weaknesses and side effects of these cleaning methods are explained related to the subject of this

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course. This is presented in a convenient overview. Contamination risks due to applied cleaning methods are highligthed also.

Wet chemical cleaning, chemical bath composition, additives and so on
Ultrasonic cleaning
Electrochemical cleaning
UV-ozone Cleaning
Steam Cleaning
Rinsing sequence
Drying issues (drying stains, aging of surfaces, corrosion and so on)

Precision cleaning technologies, part 2 (highlight innovative cleaning technologies)
This section provides general understanding and applications of the following technologies.

Dry ice cleaning
Wet ice cleaning
Liquid/supercritical CO2-cleaning
Lasercleaning
Plasmacleaning (vacuum and atmospheric)

Comparison of the cleaning technologies.

Troubleshooting and surface analysing techniques for (contaminated and cleaned) surfaces
Major surface analysing techniques for (cleaned or contaminated) surfaces are explained in a convenient overview in this part of the course. The participant gets a clear overview which enables him to choose analysing techniques for the questions about its application. Some of the highlighted analysing methods are:

Microscopy
SEM/EDS
XPS
AES
SIMS
Contact Angle
FT-IR-spectroscopy
Glow Discharge Spectroscopy

This course provides general understanding of these analysing techniques to create the basis for the participant to choose analysing technique(s) for encountering his/her questions about the (polluted or cleaned) surfaces.

For whom is this course interesting?
Engineers, managers and technologists of all kind of departments working with contaminated or polluted base materials, (semi-manufactured) products or (parts of) machines with applications in vacuum or for high tech applications. This course is also interesting for surface (coating) technologists who experience coating defects or quality losses in vacuumrelated processes like plasmatreatment, PECVD, CVD, PVD, sputtering, evaporation, thinlayer technology and so on.

This course is interesting for the following industries:
Aerospace
Automotive
Semiconductor (EUV, lithography)
Data storage (CD, harddisk fabrication)
Defence
Displays
Electronics (polymer electronics)
Industrial Products
Lightning
Pharmaceutical
Photonics
Semiconductor
Solar Photovoltaics

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Chapter 1. Contamination of the vacuum

Introduction

Due to technological developments, the application of the vacuum leads to innovative production processes and products. The composition and the level of the vacuum can have a tremendous effect on high tech processes which uses the vacuum and are underestimated in many processes. This course highlights potential contamination of the vacuum (in these processes) as it occurs in the industry. It gives also a convenient overview of phenomena which contaminate the vacuum in these high tech processes. High tech processes which use the vacuum as an important process medium are PVD (physical vapour deposition), CVD (chemical vapour deposition), EUV, lithography, vacuum heat treatment, vacuum brazing and so on. Contaminations of the vacuum can cause defects in resulting products or coatings, weak adhesion, discolorisations, black or coloured deposits, staining, loss of focussed energy (light, e-beam, UV, etc.), change in composition of coatings, induce stress in coatings, loss of precision and so on.

Contamination of the vacuum in high tech processes

This course has the goal to give a convenient overview for understanding of the applied vacuumtechnology and (risks for) related contaminations. This course gives the participant a good understanding of behaviour (cleaned) parts and materials in vacuum. This is a basis for optimising cleaning of materials which are applied in this kind of high tech vacuum processes.
This course is divided into two parts: a convenient overview of contaminations in vacuum and the effects of contaminations in vacuumprocesses.

Part 1. Contaminations of the vacuum in high tech processes

Outgassing of materials
Adsorption, absorption and desorption
Particles
Monolayer(s) of contamination
Oxidelayers on metals
Leaks, virtual leaks
Chemical reactivity of contaminations
Substrates, source materials placed in the vacuum
Behaviour of (polluted) materials in vacuum

Part 2. Effects of contamination of the vacuum in high tech processes

Effects of contamination in the vacuum of high tech processes
Conversion of contamination (energy, catalytic effects and so on)
Practical parameters to identify contamination and/or problems in the vacuum
Approaching contamination problems in vacuum
Cleaning of materials/parts for vacuum applications

For whom is this course interesting?

Engineers, managers and technologist of all kind of departments want to work with vacuum (processes) or want to apply vacuum (processes) for future innovations. Also for people who clean parts for the (clean) vacuum application and who want to understand more of the application of their parts in vacuum. This course is interesting for the following industries:

Precision components
Aerospace
Automotive
Semiconductor
Data storage
Defence
Displays
Electronics
Industrial Products
Lightning
Pharmaceutical
Photonics

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Chapter 1. Clean working for production facilities in high tech industry

Introduction

Surfaces of products/components for vacuum and high tech applications (solar, EUV, PVD, CVD, vacuumbrazing, electronics, optics and so on) have to meet increasing requirements with respect to their cleanliness. For clean working this course provides rules knowledge and experience for people in production, (mechanical and electrical) assembly and so on. Further processing at a high quality and/or zero defect requires understanding of contamination and its sources. This course is giving an overview about practical contaminations as occurring in high tech and vacuum applications. Also the effects of the contamination on the applications itself are explained. With this course participants are able to understand the (sources of) contaminations on surfaces, the effects of contaminations, the methods to remove contaminations as well as important rules for clean working.

Content of this course

Dag 1 Begrijpen van contaminatie in de praktijk

Contaminatie van oppervlakken
Soorten contaminatie (vingerafdrukken, deeltjes, oxiden, matrixen enz.)
Oorzaken en bronnen van contaminatie
Contaminatie door deeltjes in de praktijk
- Deeltjesvorming
- Bronnen van deeltjes
- Deeltjes hechting
- Deeltjes verwijdering

Monolagen van contaminatie
AMC (moleculaire contaminatie in de omgeving
Contaminatie door oppervlakte en coatingdefecten
Contaminatie door materiaaldefecten
Voorkomen van contaminatie in de praktijk
Uitleg ESD
ESD schade/defecten

Day 1 [Understanding contamination in practice]

[Contamination on surfaces]
[Kind of contaminations (fingerprints, films, particles, oxides, matrixes and so on)]
[Causes and sources of contaminations]
- [Particle contamination]
- [Particle formation]
- [Sources of particles]
- [adhesion of particles]
- [Particle removal processes]

[Monolayers of contaminations]
[AMC (Airborne Moleculair Contamination)]
[Contamination due to surface/coating defects]
[Materials defects causing contamination (porosity, inclusions,..,)
[Prevention of contaminations in practice]
[Explanation ESD (ESD = Electro Statical Discharge)]
[ESD-defects/damage, explanation ESD, solutions for ESD-problems]

Dag 2 Schoon werken in de praktijk

Effecten van contaminatie in vacuum en hoogwaardige applicaties
Regels voor schoon werken voor produktiepersoneel
Belangrijke aspecten bij schoon werken

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Samenwerking
Interventie bij fouten
Het belang van teamwork in de cleanroom
Fouten in de praktijk
Precisiereiniging (natchemisch)

Day 2 [Clean working in practice]
[Effects of contaminations on vacuum and high tech applications]
[Rules for clean working for production people]
[Essentials basis for clean working]
[Cooperation]
[Intervention]
[The importance for teamwork in de cleanroom]
[Mistakes in practice]
[Precisioncleaning (wetchemical)]

For whom is this course interesting?
This course is specially made for operators, mechanical & electrical engineers, component assemblers and production employees working in a clean(room) working area who want to learn how to work regarding this topic. Also people who clean parts for high tech applications (production, assembly and so on). This course is interesting for the employees of the following industries:

Precision components
Aerospace
Automotive
Semiconductor
Data storage
Defence
Displays
Electronics
Industrial Products
Lightning
Pharmaceutical
Photonics
Semiconductor
Solar Photovoltaics

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Chapter 2. An overview of precision cleaning technologies

Introduction

In nowadays industry several precision cleaning technologies are applicated to increase resulting quality of (semi-manufactured) products and components. Cleaning can thus be necessary as a pretreatment of (semi-manufactured) products. This course is giving an convenient overview of several precision cleaning technologies. The highlighted cleaning technologies can be used for cleaning all kinds of materials like metals, polymers, glass, fibers, woven materials, ceramics and so on.

Content of this course

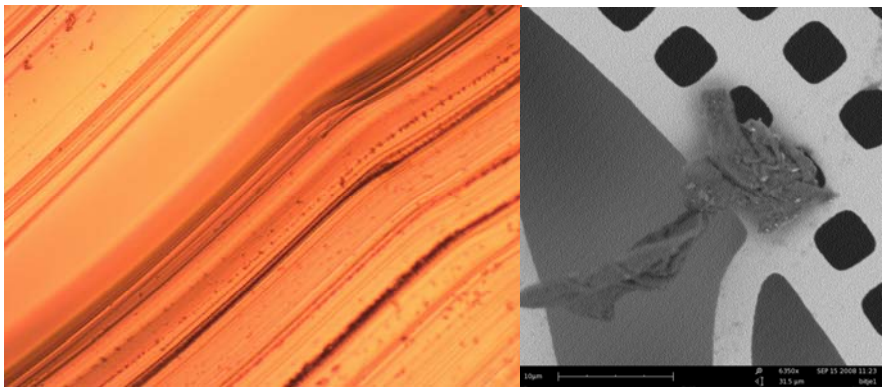
In this course the precision cleaning technologies itself, applications, possibilities, strengths and weaknesses, limitations and (negative) side effects will be highlighted. The following precision cleaning technologies will be explained:

1. Wet chemical cleaning (additives, surface-active components, acid and so on)
2. Ultrasonic cleaning
3. Electrochemical cleaning (anodic and cathodic cleaning)
4. CO_2-cleaning (liquid & supercritical & solid)
5. Cleaning with hydrofluoroethers
6. Atmospheric plasma cleaning
7. Sputter- or plasma cleaning
8. Lasercleaning

Comparisons between the technologies will be made. Also behaviour of surfaces and the different kind of pollutions will be explained. Also practical cases are explained and can be discussed. Preventing pollution and also the application of nanocoatings (easy to clean, self-cleaning and hydrofobic surfaces) are shortly highlighted.

For whom is this course interesting?

Engineers, managers and technologist of all kind of departments working with polluted base materials, (semi-manufactured) products. Of course also for people working with cleaning technologies and looking for new methods to clean (faster and/or better) for industrial purposes.



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Chapter 2. Precision Cleaning Technologies
Advanced course

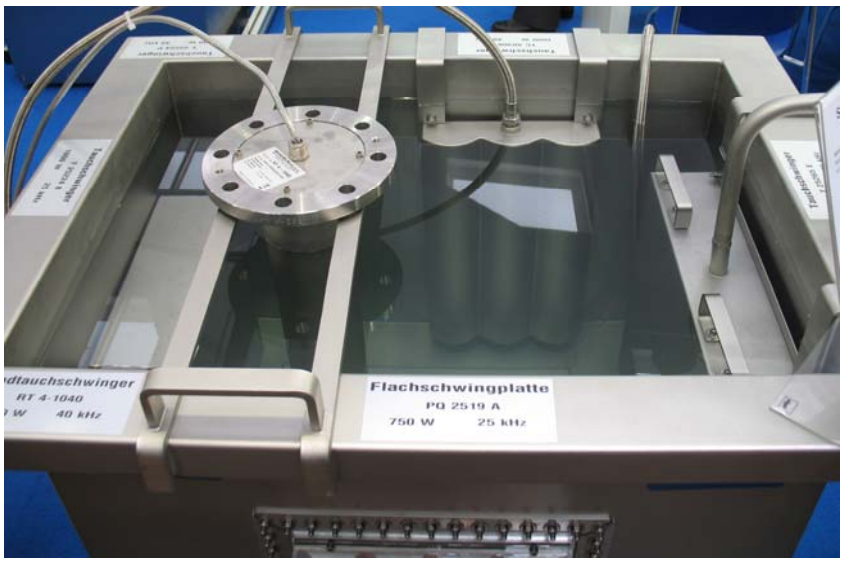
Introduction
In nowadays industry several cleaning technologies are applied to increase resulting quality of products, precision components and (semi-) manufactured parts. Precision cleaning is a sophisticated issue for the resulting quality of (semi-manufactured) products and for example of parts of machines. Many costly problems in practice arise from (drawbacks in) the precision cleaning technology itself.
This course is conveniently explaining several cleaning technologies in relation with different kind of contaminations. This overview gives an insight in the possible applicable cleaning technologies for contamination issues.
The highlighted precision cleaning technologies can be used for all kinds of materials like metals, polymers, glass, fibres, woven materials, ceramics and so on.

Content of this course
In this course the precision cleaning technologies itself, applications, possibilities, limitations and (negative) side effects (like contamination due to the cleaning method!) will be highlighted. The following precision cleaning technologies will be explained:

1. Wet chemical cleaning (additives, surface-active components, acid , alkalic and so on)
2. Ultrasonic cleaning
3. Electrochemical cleaning (anodic and cathodic cleaning)
4. CO_2-cleaning (liquid & supercritical & solid)
5. UV-cleaning
6. Wet-ice blasting
7. Sputter- or plasma cleaning
8. Lasercleaning

The cleaning technologies are overviewed in a convenient way. Comparisons between the cleaning technologies will be made. Also behaviour of surfaces (and materials below!) and the different kind of contaminations will be explained. Also practical cases are explained and can be discussed.

For whom is this course interesting?
Process & mechanical engineers, (technology) managers and (surface) technologist of all kind of departments working with contaminated/polluted (surfaces of) base materials, (semi-manufactured) products or (parts of) machines. Of course also for people working with contamination issues, (precision)cleaning technologies and looking for new methods to clean for high tech purposes.



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Chapter 2. Improving the quality and speed of wetchemical cleaning processes

Introduction

Surfaces for applications with (extremely) high requirements like vacuum and high tech applications (solar, EUV, electronics, optics and so on) have to meet now and the nearby future increasing requirements with respect to their cleanliness. Often wetchemical cleaning processes are applied to clean surfaces. But not always with good results as is necessary. The wetchemical cleaning method can cause serious practical problems due to improper application of steps in the integral cleaning process. Some of these problems can be solved by recleaning but this is leading to an extra loss of manhour and/or (cleaning)capacity. But recleaning is not always possible, which might implicate loss of products. The reliability of the cleanliness of the resulting surface and therewith also the demand on the reliability of the applied wet chemical cleaning process is gaining importance in the (high tech) industry. This workshop is organized to overview conveniently the wetchemical cleaning processes and their practical problems applied on metals like for example drying stains, corrosion and contamination. Also improvements, solutions and/or pragmatic ways to decrease these problems will be discussed with the participants.

Content of this course

This course is divided in 3 parts. During this course participants will work on practical cases and apply during teamwork their acquired knowledge and experience on interesting practical problems.

Quick overview of wetchemical cleaning methods

Wetchemical cleaning
Ultrasonic cleaning
Electrochemical cleaning
Rinsing processes
Drying processes

Problems in practice, side-effects and limitations in practice with wet chemical cleaning proceses

Pollution/contamination by the cleaning method
Side effects
Damage of the substrate
Discolorization on the surface
Delamination of coatings
Drying stains
Corrosion and so on

Working on practical cases with the participants

During the course itself but more explicitly this part cases of the industry or issues of the participants will be used as working cases to actively work on issues. This can create possibilities to encounter problems and/or create suggestions for improvement.

For whom is this course interesting?

This course is interesting for applicators of the wet chemical cleaning processes. Engineers, (production) managers and (hands on) technologists of all kind of departments working with wet chemical cleaning processes due to contaminated or polluted base materials, (semi-manufactured) products or (parts of) machines. This course is also interesting for surface (coating) technologists who experience coating defects or quality losses (loss of adhesion) because of (suspected) improper wet chemical cleaning. Also for coating technologist working with the vacuum related processes like, plasmatreatment, PECVD, CVD, PVD, sputtering, evaporation and thinlayer technology and so on. This workshop is in general interesting for the following industries:

Aerospace
Automotive
Semiconductor
Data storage
Defence
Displays

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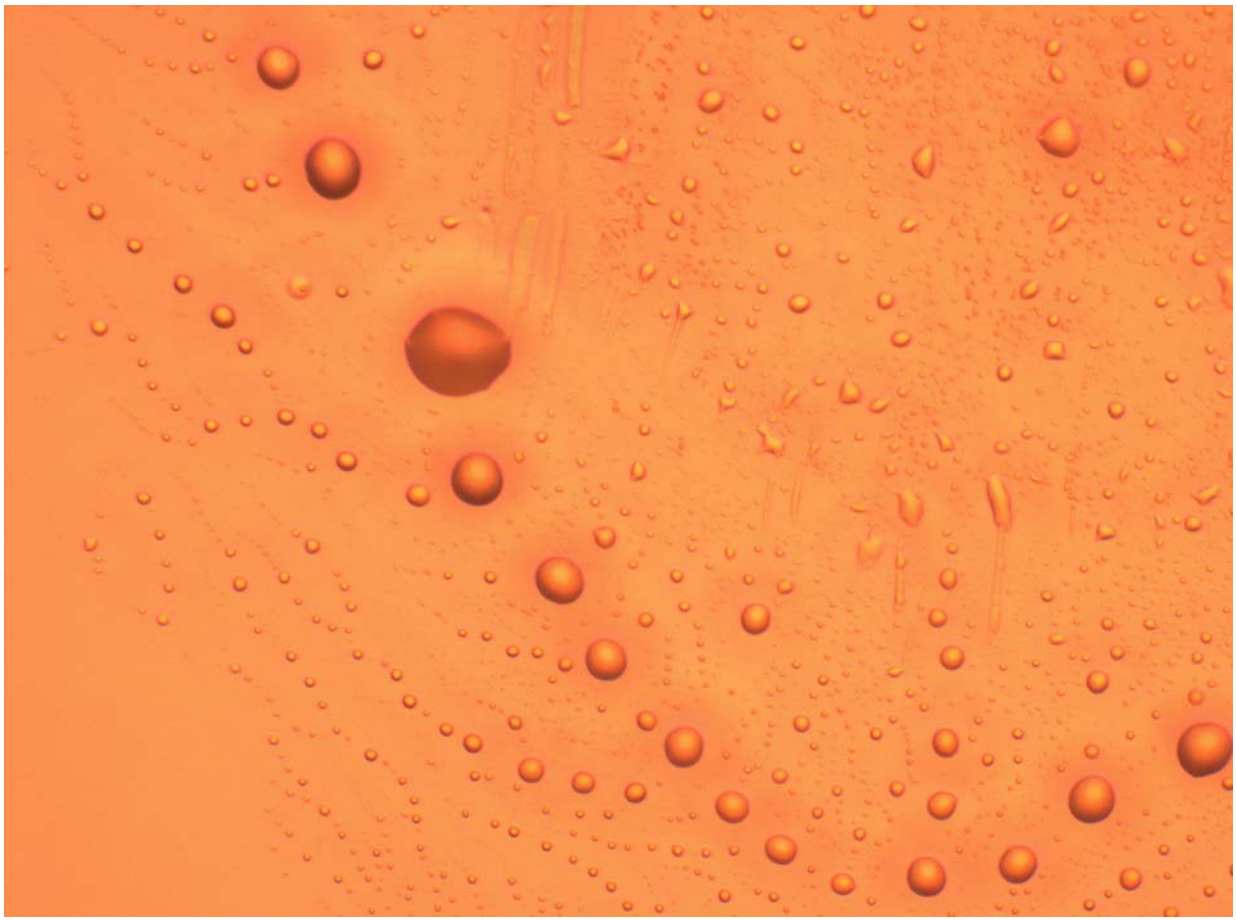
Electronics
Industrial Products
Lightning
Pharmaceutical
Photonics
Semiconductor
Solar Photovoltaics



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Chapter 2. Plasmacleaning

Introduction

In nowadays industry several precision cleaning technologies are applicated to increase resulting quality of (semi-manufactured) products and components. Plasmacleaning is gaining importance as a cleaning technology due to this increased demands of cleanliness. Plasmacleaning can be applied for pretreatment of (semi-manufactured) products. Plasmacleaning can be used for cleaning all kinds of materials like metals, polymers, glass, fibers, woven materials, ceramics and so on.
This course is giving an convenient overview for plasmacleaning as a precision cleaning technology. In this course the basics and understanding of plasmatechnology is explained in a convenient manner.

Content of this course

The plasmatechnology as a cleaning technology will be explained from the basics as well as strengths, weaknesses, possibilities and limitations. Also behaviour of surfaces and the different kind of pollutions when exposed to plasma cleaning will be explained.

- Basics plasmacleaning
- Physical aspects
- Chemical aspects
- Usage of different kind of gases during plasmacleaning
- Weaknesses and strengths
- Possibilities and limitations
- Practical problems

For whom is this course interesting?

Engineers, (production)managers and technologist of all kind of departments working with polluted base materials and/or (semi-manufactured) products. Of course also for people working with cleaning technologies and looking for new methods to clean for high tech and for example medical purposes.

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Chapter 3. Vacuum & gases in deposition technology

Introduction

Vacuum is used in processes like lithography, PVD, CVD, PECVD and plasmatreatments. The vacuum and introduced gases are forming important part of these processes. The quality of the process and resulting (semi-manufactured) products are strongly depending on (the level and the composition of) the vacuum. In the vacuum several phenomena occur which are highlighted in this course in a convenient manner.

Content of this course

In this course the fundamentals of vacuum, molecular processes and gas theory, surface phenomena in relation to the vacuum, gases & vacuum in relation to the vacuum deposition processes are explained. In this part following subjects are explained: basic definitions, properties and characteristics of gases (flows), gas laws, molecular motion, partial pressure, main free path, formation of monolayers, diffusion, adsorption, desorption, sticking coëfficiënt, outgassing and outgassing rates, outgassing of substrates, incorporation of the gas atoms in the deposited layer, consequences for the deposited layer, incorporation of gases and contaminations, overview of sources of contamination in vacuum.

For whom is this course interesting?

Engineers, managers and technologists of all kind of departments working with (semi-manufactured) products or (parts of) machines which are applied in vacuum for further processing. This course is also interesting for surface (coating) technologists who experience for example coating defects or quality losses in vacuumrelated processes like plasmatreatment, PECVD, CVD, PVD, sputtering, evaporation, thinlayer technology, lithography and so on.

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Chapter 3. Introduction to PVD Technology

Introduction

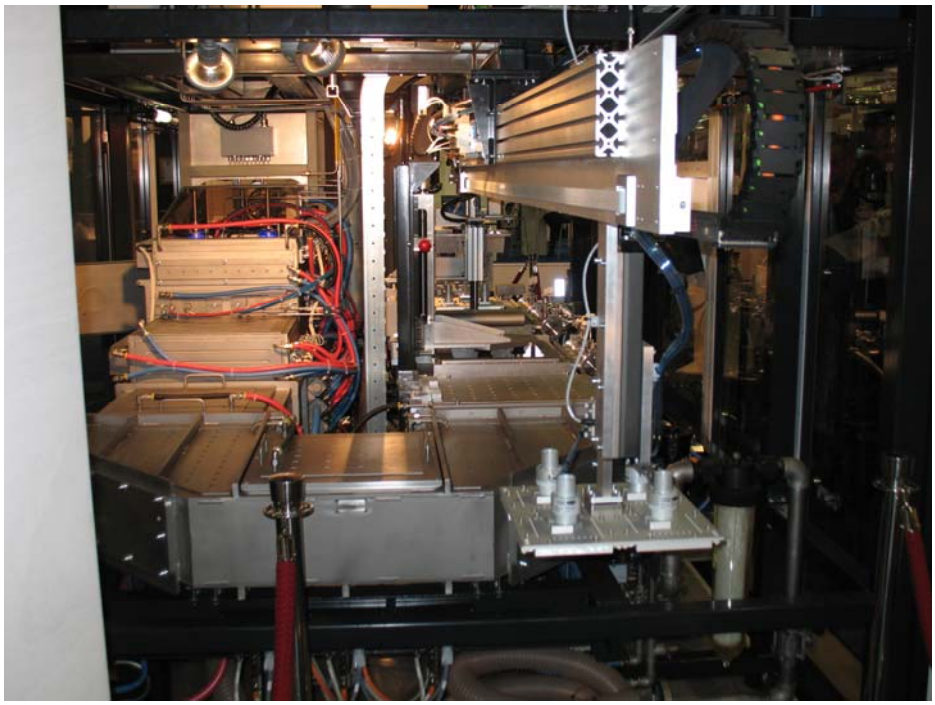
Physical Vapour Deposition technology (sputtering, evaporation, etc.), abbreviated as PVD technology, offers interesting applications for products of our every day life. From coatings on glass, metals, polymers, ceramics and so on, this interesting technology has proven already to be able to create enormous added value for several products. This course is made for the people who are relatively new in this deposition technology and want to learn about the basics of this technology.

Content of this course

In this introduction course different kind of items are explained:
- An explanation of PVD technology
- General characteristics, possibilities and limitations of PVD technology
- The different kind of processes within PVD technology (sputtering, cathodic arc, reactive sputtering, evaporation)
- An overview of PVD coatings, their properties and their applications
- Explanation of the most frequently used terms (e.g. magnetron, UBM, EB-evaporation, etching, etc.) in relation with PVD technology
- Schematic drawings of used equipment and PVD machines (glass coating, tool coating, etc.)

For whom is this course interesting?

Process engineers, engineers, managers (production, quality) and technologist of all kind of departments working with PVD-technology. Of course also for people looking for innovative possibilities to apply PVD-coatings.



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Chapter 3. PVD Technology

Introduction

Physical vapour deposition technology (sputtering, evaporation, etc.), abbreviated as PVD technology, offers interesting applications for products of our every day life. From coatings on glass, metals, polymers, ceramics and so on, this interesting technology has proven already to be able to create enormous added value for several products. Examples of products are cd's, metallized foils in the packaging industry and also glass used in buildings. This technology is able to create all kind of functionalities from wear resistant, special optical properties, conductive properties, decorative looks and so on. This course starts from the basics of this technology and gives a thorough but convenient overview of the process parameters of this interesting technology.

Content of this course

Introduction course "Gases & vacuum in deposition technology"

In this part the fundamentals of vacuum, molecular processes and gas theory, surface phenomena in relation to the vacuum, gases & vacuum in relation to the vacuum deposition processes are explained. In this part following subjects are explained: basic definitions, properties and characteristics of gases (flows), gas laws, molecular motion, partial pressure, main free path, formation of monolayers, diffusion, adsorption, desorption, sticking coëfficiënt, outgassing and outgassing rates, outgassing of substrates, incorporation of the gas atoms in the deposited layer, consequences for the deposited layer, charateristics of the incorporation of gases, sources of contamination in vacuum.

Introduction level "PVD Technology"

In this introduction course different kind of items are explained:
- An explanation of PVD technology
- General characteristics, possibilities and limitations of PVD technology
- The different kind of processes within PVD technology (sputtering, cathodic arc, reactive sputtering, evaporation)
- An overview of PVD coatings, their properties and their applications
- Explanation of the most frequently used terms (e.g. magnetron, UBM, EB-evaporation, etching, etc.) in relation with PVD technology
- Schematic drawings of used equipment and PVD machines (glass coating, tool coating, etc.)

Moderate level "PVD Technology"

In this part following subjects are explained: The relation of the vacuum and the substrate in PVD-technology and technological terms (e.g. sputter yield) are explained. The importance of the vacuum for the PVD-technology. The influences of the substrate on the coating (shading of the substrate, outgassing, etc.).
Evaporation, DC-magnetron sputtering, AC-magnetron sputtering, UBM, RF-sputtering, bias-sputtering (effect on properties of the thin layer, effect of electron- or ion bombardment), reactive sputtering (e.g. relation between the reactive flow of gases and the deposition process, hysteresis effect), cathodic arc evaporation.
The different relations in PVD-technology (e.g. voltage and current characteristics, power in relation with speed of deposition, etc.). Also schematic drawings of machines are explained. Relations of the different parameters of the process (pressure, power, temperature of the substrate, etc.) target yields (non-moving and moving targets), characteristics of magnetrons, exchange of heat in targets and constructions of magnetrons. Uniformity of the thin layer on the substrate is also explained.

For whom is this course interesting?

This course is interesting for people of R&D, engineering, technical sales, production, managers, product development, process development or people who (want to) use this innovating deposition technology.

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Chapter 3. Uniformity and quality in PVD-coatings

Introduction
In PVD (Physical Vapour Deposition)-coatings there is an enormous drive to increase the uniformity and the quality of the PVD-coating. The advantage of a better quality of the coating is mostly clear, but how can it be achieved? What are the influences on the quality and uniformity of the coating? This course is handling this topic in a convenient overview with practical examples of problems and solutions.

Content of this course
In this course the PVD-technology the aspects in relation with the uniformity and quality of the coating by PVD is handled: following topics are handled.

What is uniformity and quality?
Several aspects of uniformity are discussed:
- Uniformity of the thickness of the coating
- Uniformity of the composition (thickness, over the area)
- Uniformity of the adhesion
- Uniformity of the structure (internal stress?) of the coating
- Quality aspects of the coating

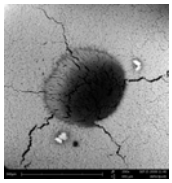
What is influencing uniformity and quality?
Vacuum and gas distribution (outgassing, leakages, contaminations, reactive gas in reactive sputtering, involvement of the deposition pollution in the interior of the machine, absorption, desorption)
Substrates (magnetron configuration, position of the substrate, properties of the surface, movement of the substrate, outgassing of the substrate, complexity of the substrates)
Processes at the target (plasmas, arcing, duration of use of the target, erosion pattern on the target, electrical field, magnetic field, disturbances in the process)
Reactivity and stability of the sputtered layer(s)
Practical process disturbances

Defects in PVD-layers
- Discolorization (oxidation, corrosion) of deposited layers
- Defects induced by the substrate
- Pinholes
- Droplets (occuring at arcing, arc evaporation)
- ESD-damage
- Relation to contamination of the machine

Increasing uniformity and quality
Increasing uniformity and quality of the coating:
- from the viewpoint of the substrate (e.g. pretreatment)
- from the viewpoint of the process (e.g. target, plasma)
- from the viewpoint of the vacuum deposition machine (e.g. maintenance)

Importance of vacuum gas analysis and the added value of surface analizing techniques is highlighted with respect to the topic of these course.

For whom is this course interesting?
Process engineers, engineers, managers (production, quality) and technologist of all kind of departments working with PVD-technology and handling the issues of uniformity and/or quality of the PVD-coating on materials, (semi-manufactured) products. Of course also for people looking for innovative possibilities to achieve more uniform and better quality PVD-coatings.



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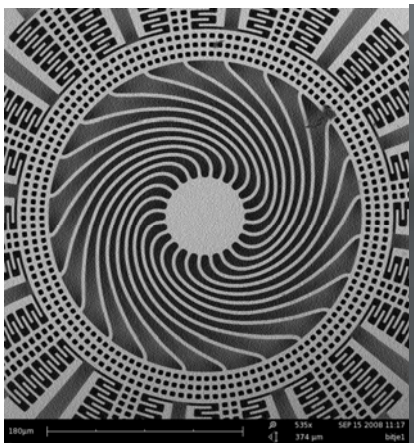
Chapter 3. Deposition technologies

Introduction
In nowadays industry several deposition technologies are applicated on (semi-) manufactured products and parts. Deposition technologies can give interesting possibilities for functionalisation of surfaces. This course is conveniently explaining several important deposition technologies as applied in industrial processes. Depending on the kind of deposition technology, it can be used for metals, polymers, glass, fibers, woven materials, ceramics and so on.

Content of this course
In this interesting course the deposition technologies, applications, possibilities, limitations and (negative) side effects will be highlighted. The following deposition technologies will be explained:

PVD (Physical Vapour Deposition)
CVD (Chemical Vapour Deposition)
ALD and nanocoatings
Galvanics and Electroless deposition
Thermal spraying (flame, arc, plasma, HVOF)

Comparisons between the deposition technologies will be made from the viewpoint of kind of process, resulting (structure of the) coating, yields, adhesion and so on. Also practical cases are explained and can be discussed.



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Chapter 3 Electroforming of nickel

Introduction
The electroforming of nickel based on nickelsulphamate electrolyte is a commonly used process for the forming of nickel (precision) substrates like (large) molds, sieves, components, stampers in CD-fabrikation, and so on. This process is thus important for the quality of the produced components. This course is handling in a convenient and interactive way the important aspects of the electroforming process for nickel as applied in industrial production.

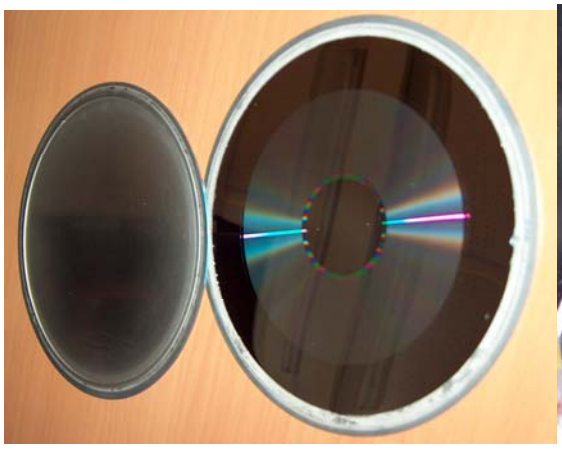
Content of this course
Below briefly the topics of this course are described. The following topics of the Electroforming process of nickel (based on nickelsulphamate electrolyte) are explained:

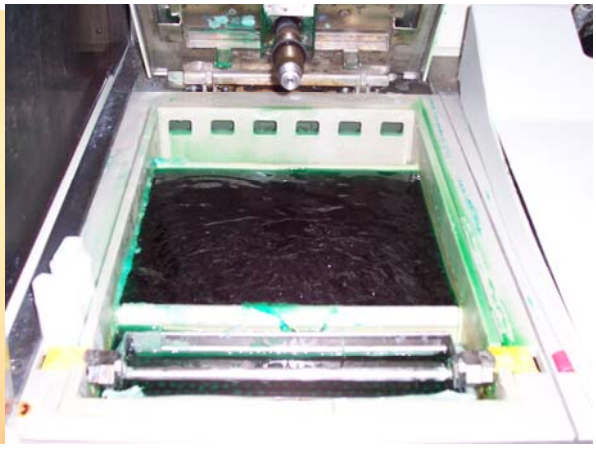
Electroforming Process:
- limitations and possibilities of the galvanic system
- layout of a galvanic system (anode, cathode, electrolyte and so on)
- electrochemical cleaning and galvanic deposition
- uniformity of the thickness
- process parameters in electrofoming
- composition of the bath
- hydrogen formation electroforming
- wetting agents
- anodic oxidation process

Properties of the nickel
- hardness of the nickel
- internal stress
- roughness
- elongation, tensile strength
- effects of pollution
- causes of defects and loss of quality in electroforming

Also practical cases are explained and can be discussed.

For whom is this course interesting?
Engineers, (production) managers and technologist of all kind of departments working with this kind of nickel electroforming process or those people who want to apply it for new products.





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Chapter 4. An overview of industrial applied plasma technology

Introduction
In several industrial processes the innovative plasma technology is more and more applied. Plasma technology is already used in hospitals for cleaning and sterilization. It is not an unreachable technology for smaller companies which have innovative ideas to apply this plasma technology on the surfaces of their products or (semi)manufactured parts.This technology can modify surfaces (metals, plastics, glass, textile and so on), clean surfaces (high tech, EUV and so on) and also treat surfaces of materials into special functionalities (eg. easy to clean). This technology is also able to form high added value coatings on different kind of surfaces. This course is starting from an introduction level and gives an convenient overview of the possibilities, limitations and side effects of plasma technology. This course is interesting for people who have ideas for applications with plasma technology and who want to understand this innovative technology for product and/or process innovation.

Content of this course
The content of this course is overviewing important aspects of this technology and its applications. This course is made conveniently to understand different aspects of plasma technology to understand (possible) applications.

Understanding of plasmatechnology
What is a plasma?
The difference between atmospheric and vacuum plasmas
Explanation of frequently used terminology in plasma technology
Explanation, possibilities, limitations and side effects of the plasma technology
Substrate handling, working gases
Plasmas applied for cleaning
Plasmas applied for etching
Plasmas applied in coating technology (chemical vapor deposition (CVD), sputtering (PVD))
Surface modifications by plasmas
Industrial applications of plasma technology
Examples of products modified or coated by plasma technology
Schematics of plasmasystems

For whom is this course interesting?
This basic course is for example interesting for people working in management, production, technical sales, quality departments and R&D.

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Chapter 4. An introduction to Plasmatechnology

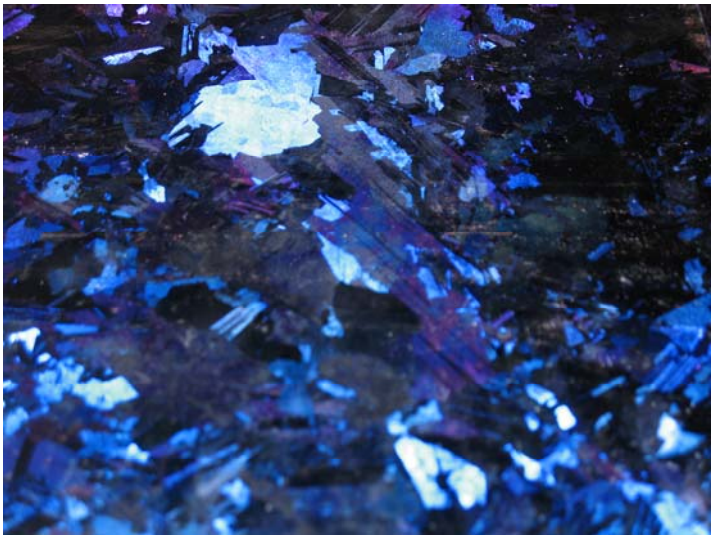
Introduction
In several industrial processes the innovative plasma technology is more and more applied. In this course this technology will be explained and also its applications in the industry will be highlighted. This technology can modify surfaces (plastics, glass, metal and so on) and treat also materials. This technology is also able to coat different kind of surfaces. This course is starting from an introduction level and gives an convenient overview of the possibilities, limitations and side effects of this technology. This is a course to explain this technology and is interesting for people working (or selling equipment) with plasma technology and who want to understand this innovative technology.

Content of this course
The content of this course is divided in mainly two parts. The first part explains the plasmatechnology. The second part explains industrial applications of this technology. This course is made conveniently to understand different aspects of plasma technology.

Understanding plasmatechnology
Basic but short explanation of physics
Explanation of frequently used terminology in plasma technology
Explanation, possibilities, limitations and side effects of the plasma technology
Substrate handling, working gases
Surface modification by implantation and diffusion
Plasmas applied in cleaning, etching, chemical vapor deposition (CVD), sputtering (PVD) and so on.

Industrial applications of plasma technology
Examples of products modified or coated by plasma technology
Schematics of plasmasystems
Equipment used in plasmatechnology

For whom is this course interesting?
This basic course is for example interesting for people working in management, production, technical sales, quality departments and R&D.



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Chapter 4. Advanced course Plasmatechnology

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Chapter 5. Surface and materials technology for mechanical engineers in the high tech industry

Please ask for further information by e-mail to info@rtcenp.org!

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Chapter 5. Effects of hydrogen in metals

Introduction

In the industrial practice several processes are applied on metals which enhance the adsorption an absorption of hydrogen. Sometimes the purchased materials are heavily contaminated with hydrogen and creates a lot of problems for the manufacturing companies or even worse for their customers. The effects of hydrogen in metals can have serious adverse side-effects.

The most well known processes are wetchemical and galvanic processes are applied on metals, but also plasmacleaning with hydrogen is not free of risk. By some of these processes the hydrogen will be formed at the surface and penetrate the metal. Hydrogen can be (temporarily) absorbed in the metal. Due to this effect wanted but mostly unwanted effects can occur.

Hydrogen in the coated base metal can cause, bubbling, wrinkling, blistering, delamination of the subsequent coating(s). One well known unwanted effect affecting the base metal is hydrogen embrittlement hich can lead to failure of the metal product.

A wanted effect is the formation of microcracks in galvanic chromium deposits due the desorption of the hydrogen by the chromium layer.

Due to the risks of hydrogen embrittlement it is important to know the characteristics of the phenomenon when using galvanic processes.

The goals of this course

The goals of this practical course is to explain important issues of the formation of hydrogen, the absorption of hydrogen in metals, the material and coatingproblems related to hydrogen, desorption and the embrittlement due to hydrogen.

Content of this course

In this course following topics are explained:

The processes which introduce hydrogen into the metal (pickling, etching, deposition of metals, galvanic, electroless, cathodic cleaning, hydrogen plasma cleaning, etc.)

Diffusion of hydrogen in the metal

The formation of hydrogen in galvanic processes(e.g. current density, dependency of the pH, concentration of the metal ions, additives, partial hydrogen pressure, etc.)

The phenomena of hydrogen in metals (embrittlement, shrinkage of the volume, failure, and so on)

The recognition of hydrogen embrittlement

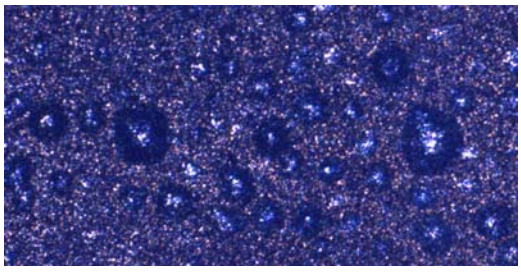
Formation of defects of coated products (bubbles in coatings, blistering, delamination of coatings and so on) and stains by hydrogen

The possibilities to reduce and/or the avoiding of hydrogen embrittlement in industrial practice.

Removal of hydrogen

For whom is this course interesting?

(Process and mechanical) engineers, (production) managers and (coatings, surface and materials) technologist of all kind of departments working with this kind of hydrogen contamination and/or problems.



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Chapter 6. Technology Management
Protection of confidential information in cooperation with external parties

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Chapter 6. Technology Management
Important sources for technological information in R&D/Technological projects

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