all. 1

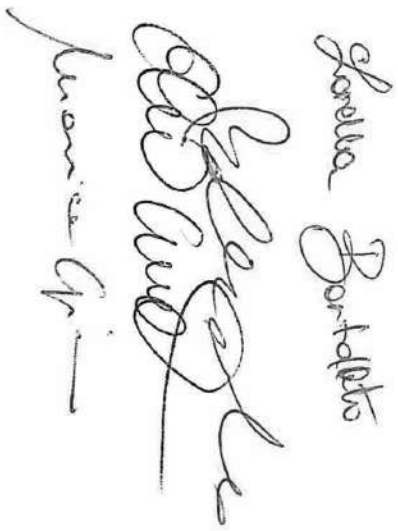
SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.16

1. Proporre un metodo per misurare la densità di un materiale.
2. Descrivere le procedure di sicurezza da adottare per lo smaltimento di liquidi contaminati.

Valutazione conoscenze informatiche

- Che approccio informatico utilizzerebbe per la prenotazione dell'uso delle strumentazioni di laboratorio comuni?



(16)

Chapter Twenty-Five

Nuclear Magnetic Resonance (NMR) Spectroscopy

What Does This Technique Measure?

Nuclear Magnetic Resonance (NMR) is used to study the chemical and physical structures of molecules. It is commonly used to study both organic and inorganic materials. When properly excited in a strong magnetic field, certain atomic nuclei resonate as functions of their bonding (number of bonds, bond angles, and bond strengths) and structural positions within molecules and materials. This is primarily a research tool.

Why Is NMR Important?

This non-destructive technique allows the study of the structures and bonding within many materials. At lower magnetic field intensities, enhanced NMR techniques have been developed to analyze living tissues.

Fundamentals

When exposed to strong magnetic fields, the axes of rotation of the spins of atomic nuclei precess about the axis of the applied magnetic field. When also exposed to certain frequencies in the radio frequency (RF) range that match the natural precession frequency, the spin axes will absorb energy and resonate. When resonance occurs, a

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.15

1. Proporre un metodo per misurare il contenuto di acqua di un materiale solido.
2. Descrivere le procedure di sicurezza da adottare per lo smaltimento di solidi contaminati.

Valutazione conoscenze informatiche

- Che approccio informatico utilizzerebbe per la gestione e calendarizzazione delle manutenzioni programmate delle strumentazioni di laboratorio?

Chapter Twenty-Eight

Scanning Electron Microscopy (SEM)

What Does This Technique Measure?

Scanning Electron Microscopes (SEMs) are commonly used to study surfaces, structures, morphologies, and forms of raw and fired materials. Fracture surfaces and polished sections allow studies of the interiors of wares.

The images viewed using SEMs are created by detecting secondary electrons ejected from samples as they are bombarded by focused, high energy electron beams. Unlike optical microscopy, one does not look through lenses at the actual sample, but one observes images of the sample created by the instrument's electronics.

SEMs can achieve higher magnifications than optical microscopes. When samples are probed with focused electron beams, a variety of signals can be collected and displayed on the view screen. In addition to secondary electron signals, X-rays characteristic of the elemental composition of the sample can be mapped to sample images, and back-scattered electrons can also be collected and displayed. When SEMs are fitted with appropriate detectors, one can not only see images of the samples (using secondary and back-scattered electron signals) but one can also see images which map the elemental compositions of the samples.

SEM analyses are conducted in vacuum environments. All non-conductive samples must be coated with electrically conductive coatings before they can be observed in SEMs.

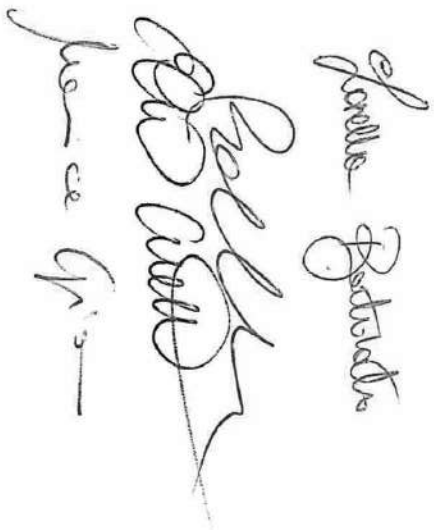
SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.14

1. Proporre un metodo per misurare la porosità di un materiale.
2. Descrivere le procedure di sicurezza da adottare per lo smaltimento di residui di materiale biologico (non di derivazione umana).

Valutazione conoscenze informatiche

- Come gestirebbe e allestirebbe un archivio virtuale per raccogliere le procedure operative delle strumentazioni di laboratorio?



Chapter Thirty-One

Gas Chromatography

What Does This Technique Measure?

Gas Chromatography (GC) is a gas separation technique. Gas samples are carried through long chromatography columns (small diameter tubes) by carrier gases. The insides of chromatography columns are coated by a variety of non-volatile liquids and chemical substances which can be further tailored with a wide variety of attached functional groups. As sample gases are carried through the columns, individual species are dynamically attracted to the coatings. This can take the form of dynamic adsorption and desorption again after small residence times. The attraction of each gas species to each coating varies slightly.

The dynamic attraction/interaction/adsorption/desorption processes separate gas species as they flow through the long columns. Gases with the least attraction to coatings pass through most quickly. Other gases with stronger attraction/adsorption/residence time/desorption behaviors pass through the columns more slowly. Gas molecules enter the chromatography columns as homogeneous sample mixtures, but they exit the columns separated into individual, distinct species.

This technique is used on many organic molecules that are naturally gaseous, or easily vaporized at slightly elevated temperatures. The compositions of many complex industrial, refinery, fuel cell, and natural gases are routinely identified using gas chromatography.

all. 1

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.13

1. Proporre un metodo per misurare la resistenza alla compressione di un materiale.
2. Descrivere le procedure di sicurezza da adottare per lo smaltimento di residui di basi.

Valutazione conoscenze informatiche

- Come gestirebbe e allestirebbe un archivio virtuale per le schede di sicurezza del reagentario di laboratorio?

significant gradients created by ion implantation in the first micrometer of depth of this sample.

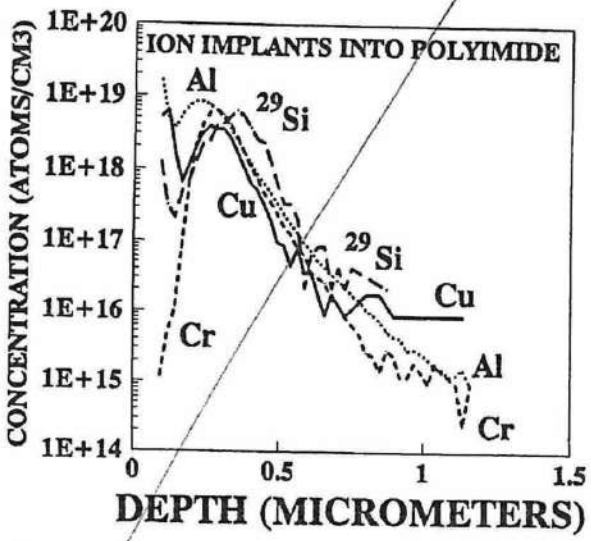


Figure 22-2. SIMS depth profile of Al, ^{29}Si, Cr, and Cu ion implants into polyimide. Implant energies were 100, 150, 150, and 150 keV, respectively, for the different species. Implant doses were 1 x $10^{14}/cm^2$. (Courtesy of C. Park and P. Flaitz, IBM Microelectronics, Hopewell Junction, NY.)

Chapter Twenty-Three

Energy Dispersive Spectroscopy (EDS)

What Does This Technique Measure?

Energy Dispersive Spectroscopy (EDS) measures the energies of X-rays which are emitted from atoms after they have been ionized by high energy electron beams or by X-ray beams. All emitted X-rays are characteristic of the elements from which they were emitted. This technique is useful to identify all elements with atomic numbers of 5 (boron) and higher.

This is a surface analysis technique which is performed in vacuum. It can be used for both qualitative and quantitative analyses. It is primarily a research tool used in conjunction with other techniques such as electron microscopy, electron microprobe, or XRF analyses.

Why Is EDS Important?

Energy dispersive spectroscopy is important because it is a handy method for identifying elemental compositions. When samples are studied using focused electron beams, such as they are in scanning electron microscopes (SEM), a variety of signals are given off from the samples. SEMs are primarily designed to detect, amplify, and display secondary electrons emitted when focused electron beams impact samples. But in addition to secondary electrons, focused electron beams also cause characteristic X-rays to be emitted from the samples.

all. 1

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.12

1. Proporre un metodo per misurare la resistenza alla trazione di un materiale.
2. Descrivere le procedure di sicurezza da adottare per lo smaltimento di residui di acidi.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per redigere un certificato relativo a prove conto terzi?

through a monochromator, to a detector. The absorption of incident energy of the characteristic frequency for each metal directly corresponds to the quantity of vaporized ground state atoms of that metal present in the flame. Calibrations are performed using standard solutions.

Table 20-1 shows a sample AAS analysis of a tile glaze. Glaze samples were prepared using sodium hydroxide fusion and acid digestion techniques. Digested samples were diluted appropriately before analysis of each element. Samples were vaporized in nitrous oxide-acetylene or air-acetylene flames.

Table 20-1. Atomic Absorption Analysis of a Tile Glaze Sample. (Courtesy of GBC Scientific Equipment Pty Ltd, Melbourne, Australia.)

Element	Wavelength (nm)	Measured conc. (mg/L) in solution	Elemental conc. (%) in solid	Oxide conc. (%) in solid
Si	251.6	52	20.7	44.2
Al	309.2	19.2	3.8	7.2
Na	330.2	52	10.1	13.6
K	766.5	0.6	1.2	1.4
B	249.8	159	9.06	29.2
Ca	422.7	2.76	5.5	7.7

The GBC Avanta AAS System* automatically optimizes wavelength, slit width, and lamp current for analysis of each element, and it has an eight lamp fully automated turret and a programmable flame control.

* GBC Scientific Equipment Pty Ltd, Melbourne, Australia.

Chapter Twenty-One

Mass Spectrometry

What Does This Technique Measure?

Mass Spectrometry (MS) measures the masses of compounds and fragments released when matter is exposed to high energy electron, atom, ion, or pulsed laser beams. When excitation beam energies are sufficiently high, targeted materials or compounds can break into fragments with unique size (mass) distributions characteristic of their elemental and structural compositions. In all cases, ionized compound and material fragments are accelerated by electric fields and manipulated by magnetic fields to separate them according to their masses. Characteristic fragment mass distributions allow identification of compounds and materials.

Mass Spectrometry is a research tool performed in vacuum environments. All elements can be identified using this technique.

Why Is Mass Spectrometry Important?

Mass spectrometry is one way to analyze and identify the composition of gaseous, liquid, and solid compounds and fragments of ceramics, materials, industrial chemicals, biological samples, pharmaceuticals, environmental chemicals, petroleum chemicals, etc. Quantitative as well as qualitative studies are possible.

Although mixtures of materials produce increasingly complex analyses, they can nevertheless be analyzed using this technique. MS instruments are frequently coupled with separation techniques such as gas and liquid chromatography to increase the utility of results.

all. 1

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.11

1. Proporre un metodo per misurare la viscosità di un materiale.
2. Descrivere le procedure di sicurezza da adottare per il reintegro del livello di azoto liquido in un contenitore criogenico.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per redigere un documento divulgativo sulle norme da seguire in laboratorio?

Lorella Bortolato

Maria Gi

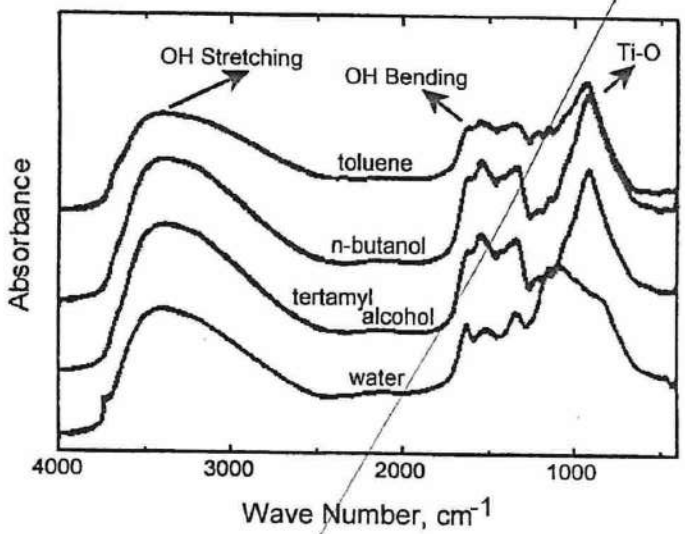


Figure 16-1. Barium titanate nanoparticles prepared by Ambient Condition Sol (ACS) process from different solvent media.[1,2] (Courtesy of Burt Lee, Clemson University, Clemson, SC.)

References Cited

1. Wang, X., Lee, B.I., Hu, M., and Payzant, A., "Synthesis of Nanocrystalline Barium Titanate in Various Media via Ambient Condition Sol Process," *J. Matr. Sci. Lett.*, **22**, 557-559 (2003).

2. Wang, X., Lee, B.I., Hu, M., and Payzant, A., "Kinetics of Nanocrystalline Barium Titanate via Ambient Condition Solution Process," *J. Matr. Sci., Materials in Electronics*, **14**, 495-500 (2003).

Chapter Seventeen

Raman Spectroscopy

What Does This Technique Measure?

Similar to IR spectroscopy, Raman spectroscopy also studies molecular vibrations. Raman spectroscopy is sensitive to vibration modes associated with changes in electronic polarizability, while IR absorption spectroscopy (covered in the previous chapter) is sensitive to vibration modes associated with changes in dipole moments.

When exposed to laser light in the UV-visible-IR ranges, incident photons are scattered by sample materials. The strongest scattering occurs at the same frequency as the incident radiation, but the frequencies of some scattered photons are shifted from the incident frequency by the energy of certain Raman-sensitive vibrational modes.

Raman scattering is weak scattering at frequencies both higher and lower than the incident radiation frequency. The strong incident intensities of lasers have helped the detection of the weak Raman scattering.

Raman spectroscopy is primarily used to identify bond types, structures, and functional groups in organic compounds. Samples as small as ~0.03μg can be analyzed in Raman spectrometers. High resolution Raman spectrometers are available for research applications. Less expensive instruments in the category known as Low Resolution Raman Spectroscopy (LRRS) are also available which can be used to identify materials, for quality and process control applications, and for R&D purposes.

all. 1

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.10

1. Descrivere le principali caratteristiche tecniche e gli usi di strumento ad assorbimento atomico.
2. Descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento di una bombola di ossigeno ad alta pressione.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per comunicare in maniera selettiva con i frequentanti di uno specifico laboratorio?

Chapter Sixteen

IR Spectroscopy

What Does This Technique Measure?

Infrared (IR) spectroscopy measures the absorption of IR radiation by materials as the atoms vibrate about their bonds. It is primarily used to identify bond types, structures, and functional groups in organic and inorganic compounds. IR sensitive vibrations are associated with changes in dipole moments, while Raman sensitive vibrations (covered in the next chapter) are associated with changes in electronic polarizability.

Samples of ~0.2g are needed for analysis using this technique. IR spectroscopy is routinely used for research purposes and to identify materials.

Why Are IR Absorption Spectra Important?

Molecules absorb IR radiation at frequencies related to their unique compositions, structures, and the numbers, types, strengths, and positions of their bonds. Because molecular vibrations are uniquely related to compositions and structures, infrared spectroscopy can be used to identify molecules, functional groups, and molecular structures.

Fundamentals

IR spectroscopy measures vibrational energy levels in molecules. It can be used for both qualitative and quantitative analysis,

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.9

1. Descrivere le principali caratteristiche tecniche e gli usi di un gascromatografo.
2. Descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento di una bombola di gas inerte (Azoto 99.99%) ad alta pressione.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per gestire l'inventario del reagentario di laboratorio?

Chapter Fourteen

Fluid Viscometers

What Does This Technique Measure?

Viscometers measure viscosities of fluids and suspensions. When viscosities are measured at a variety of shear rates, which is possible with many instruments, viscometers also then measure rheological properties.

Several hundred ml (and less, depending upon the viscometer) of each sample are required for viscosity measurements.

Viscous and rheological properties are routinely measured for daily process control purposes, as well as for research and development activities.

Why Are Viscosity and Rheology Measurements Important?

Measured viscosities and rheologies directly correlate to the behaviors of bodies and suspensions during processing.[1,2] Many processing problems can be predicted (and prevented) when they are identified by viscous and rheological measurements.

Viscosities and rheologies are the products of proper (or improper) control of fundamental, causal, suspension properties. Having determined from a measured rheogram **that** a suspension does not have the desired viscous or rheological properties, one must then decide **which** of the causal properties is directly responsible for the particular problem and **how** the identified causal property (or properties) can be adjusted to correct the problem.

all. 1

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.8

1. Descrivere le principali caratteristiche tecniche e gli usi di un diffrattometro a raggi X.
2. Sulla base delle caratteristiche della soluzione di formaldeide di cui alla scheda di sicurezza allegata, descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento della stessa.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per rappresentare in forma grafica i risultati di prove sperimentali?

Soluzione di formaldeide ≥35 %, DAB, per istologia

Composizione miscela

Denominazione sostanza	% in peso
Formaldeide	30-50
Metanolo	≤ 15

SEZIONE 2: Identificazione dei pericoli
2.1 Classificazione della sostanza o della miscela
Classificazione secondo il Regolamento (CE) n. 1272/2008
H301+H311+H331; H314; H317; H335; H341; H350; H370
Per quanto riguarda il testo completo delle indicazioni di pericolo menzionate in questo paragrafo, riferirsi al paragrafo 16.
2.2 Elementi dell'etichetta
Etichettatura secondo il Regolamento (CE) n. 1272/2008 (CLP)
Pittogrammi

Pericolo

Indicazioni di pericolo
H301+H311+H331
H314
H317
H335
H341
H350
H370

Consigli di prudenza
prevenzione
P260
P280
reazione
P303+P361+P353
P304+P340
P305+P351+P338
P308+P311

standards for compositions of interest should all be readily available from XRF instrument manufacturers.

When samples are sent out to analysis labs for XRF analysis, all of these details should certainly be taken into account by the labs performing the analyses.

References Cited

1. Holdridge, D.A., "The Mineralogy of Some American Ball Clays," *Trans Brit. Ceram. Soc.*, **62**, pp. 857-865, (1963).

2. Funk, J.E., and Dinger, D.R., "Chapter 44 Mineral Analysis of Clays," Predictive Process Control of Crowded Particulate Suspensions Applied to Ceramic Manufacturing, pp. 692-698, Kluwer Academic Publishers, Boston, MA (1994).

Chapter Ten

X-Ray Diffraction (XRD)

What Does This Technique Measure?

X-Ray Diffraction (XRD) analysis, performed on powder samples, identifies the mineralogical compositions of samples by identifying their crystalline structures. XRD can be used both qualitatively and quantitatively.

XRD analysis is performed on small powder samples (several grams). It is used to identify mineralogical compositions and crystal structures of raw materials and crystal structures in fired wares. It is commonly used as a research tool to analyze crystal structure variations that accompany compositional, processing, and firing changes during the production process. Since this technique only identifies crystalline structures, it **cannot** be used to analyze amorphous materials.

Why Is X-Ray Diffraction Important?

X-ray diffraction analysis of powders is important because it is the one common technique that can directly identify crystalline phases (and mixtures of crystalline phases) in powder samples. XRD cannot be performed on vitreous samples because the technique is based upon the distances between long-range-ordered atomic planes in crystals. No such long-range-ordered atomic planes exist in melts and amorphous materials.

Diffraction patterns of individual ingredients intended for use in ceramic bodies can clearly identify the crystalline phases present in each. For this reason, X-ray diffraction patterns can be used to qualify

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.7

1. Descrivere le principali caratteristiche tecniche e gli usi di un microscopio ottico.
2. Sulla base delle caratteristiche del metanolo di cui alla scheda di sicurezza allegata, descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento dello stesso.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per analizzare i dati acquisiti in un esperimento?

Metanolo

Formula: CH_4O
Peso molecolare: 32,042 g/mol
Proprietà chimico-fisiche

Densità (g/cm3, in c.s.)	0,79
Indice di rifrazione	1,3288
Temperatura di fusione	−97 °C
Temperatura di ebollizione	64,7 °C
$\Delta_{cb}H^0$ (kJ·mol−1)	37,4

Proprietà termochimiche

Δ_fH^0 (kJ·mol−1)	−239,2
Δ_fG^0 (kJ·mol−1)	−166,6
S^0_m(J·K−1mol−1)	126,8
$C^0_{p,m}$(J·K−1mol−1)	81,1

Indicazioni di sicurezza

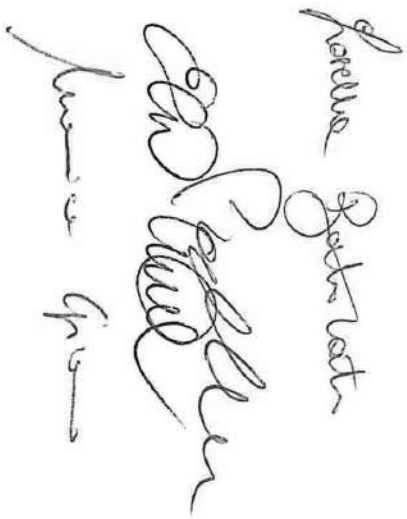
Punto di fiamma	11 °C (284 K)
Limiti di esplosione	7 - 44% vol.
Temperatura di autoignizione	455 °C (728 K)

SEZIONE 2: Identificazione dei pericoli
2.1 Classificazione della sostanza o della miscela
Classificazione secondo il Regolamento (CE) n. 1272/2008
H225; H301; H331; H311; H370
Per quanto riguarda il testo completo delle indicazioni di pericolo menzionate in questo paragrafo, riferirsi al paragrafo 16.
Classificazione secondo le Direttive EU 67/548/CEE o 1999/45/CE
R11; R23/24/25, R39/23/24/25
Per il testo completo delle frasi R menzionate in questa sezione, riferirsi alla sezione 16.
2.2 Elementi dell'etichetta
Etichettatura secondo il Regolamento (CE) n. 1272/2008
Pittogramma

Pericolo

Indicazioni di pericolo
H225
H301 + H311 + H331
H370

Consigli di prudenza
P210
P260
P280
P301 + P310
P311



Chapter Nine

X-Ray Fluorescence (XRF)

What Does This Technique Measure?

X-Ray Fluorescence (XRF) is used for quantitative elemental analysis of materials, including ceramic powders, metals, and fired bodies. XRF techniques can be used to analyze elements with atomic numbers >= 5 (B).

This technique requires small pressed pellets of powder samples or similarly sized slices of fired ceramics and metals. It is routinely used to characterize elemental compositions of raw materials and to check the elemental compositions of production bodies. It is both a research and development tool and a quality control tool.

Why Is X-Ray Fluorescence Important?

XRF provides a quick and easy way to quantitatively measure the elemental composition of raw materials and bodies. It is not possible to detect and analyze all elements with this technique, but the major elements in most materials and bodies can be precisely and accurately measured.

What is the elemental composition of a body? What is the elemental composition of a raw material? What percentage of iron impurities are in a particular material? Which alkalis, and what percentage of each, are present in the feldspathic minerals available for use in a body? These types of questions can be answered using XRF techniques.

all. 1

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.6

1. Descrivere le principali caratteristiche tecniche e gli usi di uno spettrometro di massa.
2. Sulla base delle caratteristiche del clorobenzene di cui alla scheda di sicurezza allegata, descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento dello stesso.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per registrare i dati acquisiti in un esperimento?

Clorobenzene

Formula: C_6H_5Cl
Peso molecolare: 112,6 g/mol
Proprietà chimico-fisiche

Densità (g/cm3, in c.s.)	1,11 (20 °C)
Solubilità in acqua	0,05 g /100 ml (20 °C)
Temperatura di fusione	−45 °C (228 K)
Temperatura di ebollizione	132 °C (405 K)

SEZIONE 2: identificazione dei pericoli
2.1 Classificazione della sostanza o della miscela
Classificazione secondo il Regolamento (CE) n. 1272/2008
H226; H332; H315; H411
Per quanto riguarda il testo completo delle indicazioni di pericolo menzionate in questo paragrafo, riferirsi al paragrafo 16.
2.2 Elementi dell'etichetta
Etichettatura secondo il Regolamento (CE) n. 1272/2008
Pittogramma

Attenzione

Indicazioni di pericolo
H226
H315
H332
H411

Consigli di prudenza
P210
P261
P370 + P378

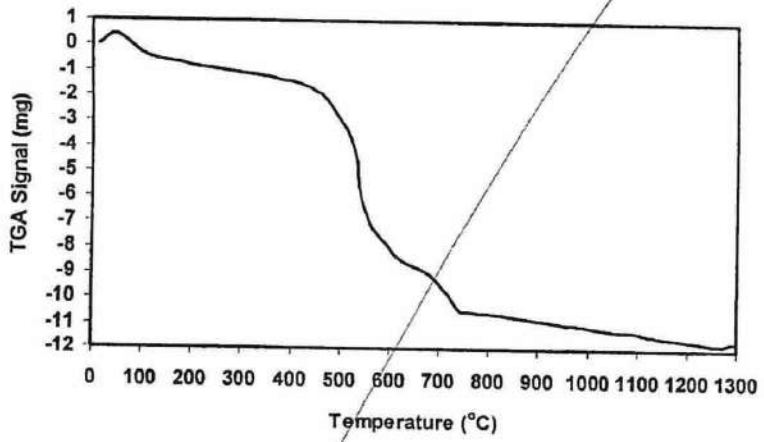


Figure 6-2. TGA of a typical whiteware body.

to ~700°C. This weight loss corresponds to the release of the chemical water from the kaolinite structure, as well as to organic binder burnout. Correlating TGA results (such as those in Figure 6-2) with DTA results (such as those in Figure 5-1) can provide lots of useful information concerning the firing behaviors of ceramic wares.

Chapter Seven

Thermal Dilatometry

What Does This Technique Measure?

Thermal Dilatometry measures the length of a sample as it is heated and cooled through a standard firing program. Thermal Dilatometry follows the expansion and contraction of samples as they are fired.

When dilatometer samples are unfired powder compacts of body compositions, dilatometer traces show the complete expansion/contraction behavior to be expected during first firing of production wares. Such analyses are known as *irreversible* thermal expansion measurements.

When dilatometer samples are pieces of fired body or glaze, the dilatometer traces can be used to measure coefficients of thermal expansion of the materials. Such analyses are known as *reversible* thermal expansion measurements.

Thermal dilatometry requires samples which are small bars or rods (~¼" diameter by 1" long.) These can be compacted bars of powders or bodies, or similarly sized bars cut from finished wares. If a fired piece of glass or glaze is to be analyzed, samples must be melted in a furnace, cooled, and then cut to the appropriate size.

Thermal dilatometry is a tool routinely used for research and development of ceramic wares. It is especially useful for measuring thermal expansion coefficients of ware and glaze samples to monitor, adjust, and control glaze-to-body fit.

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.5

1. Descrivere le principali caratteristiche tecniche e gli usi di un microscopio elettronico (si scelga se a scansione, SEM, o a trasmissione, TEM).
2. Sulla base delle caratteristiche dell'acido nitrico di cui alla scheda di sicurezza allegata, descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento dello stesso.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per redigere un rapporto dei risultati di una sperimentazione eseguita?

Acido Nitrico

Formula: HNO_3
Peso molecolare: 63,01 g/mol
Proprietà chimico-fisiche

Densità (g/cm3, in c.s.)	1,52 a 20 °C
Solubilità in acqua	completa
Temperatura di fusione	−42 °C (231 K)
Temperatura di ebollizione	83 °C (356 K) con decomposizione
Tensione di vapore (Pa) a 293 K	400

Proprietà termochimiche

$\Delta_f H^0$ (kJ·mol−1)	−174,1
$\Delta_f G^0$ (kJ·mol−1)	−80,7
S^0_m(J·K−1mol−1)	155,6
$C^0_{p,m}$(J·K−1mol−1)	109,9

Indicazioni di sicurezza

TLV (ppm)	7,73 (TLV-STEL)
	4,01 (TLV-TWA)

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2. Identificazione dei pericoli
2.1 Classificazione della sostanza o della miscela:
Classificazione ai sensi del Regolamento (CE) N. 1272/2008:
Pittogrammi:

Pericolo

2.2 Elementi dell'etichetta:
Etichettatura conforme al regolamento (CE) n. 1272/2008

Codici di indicazioni di pericolo:
H272
H290
H314
H331
EUH071

Consigli di prudenza:
Prevenzione
P280
Reazione
P301 + P330 + P331.
P304 + P340
P305 + P351 + P338
P308 + P310

samples are heated together in the firing chamber at predetermined (usually constant) temperature ramp rates, and the temperature of each powder is measured by a thermocouple located at the center of each cell. The difference between the temperatures of the two cells is the DTA value of interest.

The areas under the peaks (and above the valleys) indicate the magnitudes of the reactions or transformations taking place.

Figure 5-1 shows a DTA curve for a typical whiteware body. This figure shows the difference in temperature between a whiteware sample and an alumina standard versus temperature. Units of the DTA signal (ΔT) are μV, which represents the difference between the sample and standard raw thermocouple signals.

Some of the broad curvature of this DTA trace (to higher temperature differences over the 300-800°C range) is due to burnout of organic materials in the body. The large endothermic reaction (the deep valley) in the 400-600°C range represents the release of chemical water from clay minerals in the body. Other DTA peaks and valleys can similarly be identified and correlated to chemical reactions that take place during firing and to chemical compositions of sample minerals and bodies.

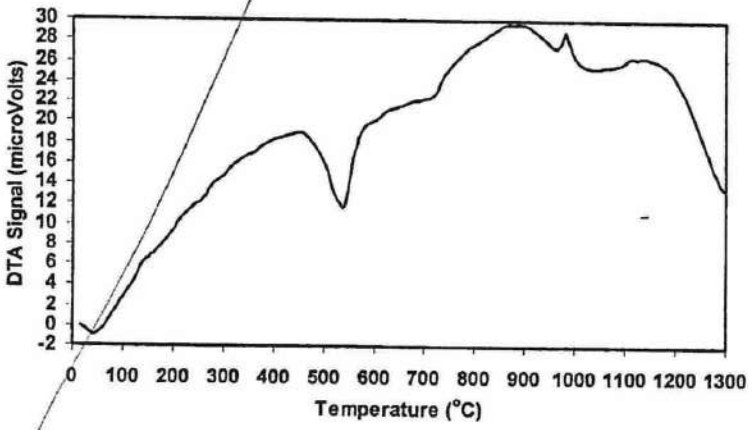

Figure 5-1. DTA of a typical whiteware body.

Chapter Six

Thermal Gravimetric Analysis (TGA)

What Does This Technique Measure?

Thermal Gravimetric Analysis (TGA) measures the masses of samples as they are heated and cooled through standard firing programs.

TGA analyses are very similar to DTA analyses. In the case of TGA analyses, the increases, decreases, or constancy of mass of samples at each temperature in the firing program indicates the presence or absence of reactions and the nature of each reaction that takes place. For example, phase changes occur without change of mass; some combination reactions occur without change of mass; some decomposition reactions are accompanied by weight losses; and oxidation reactions are accompanied by weight gains.

TGA analyses require small samples (several grams) of dry powders or particulate suspensions. All such samples must be thoroughly dried before performing the analyses. Similar to the DTA analysis technique (discussed in the previous chapter) TGA analyses are also routinely used to identify and characterize raw materials, and aid in research and development activities during body development. Some modern instruments simultaneously perform DTA and TGA analyses.

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SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.4

1. Descrivere le principali caratteristiche tecniche e gli usi di un cromatografo liquido ad alta prestazione (HPLC).
2. Sulla base delle caratteristiche dell'etanolo assoluto di cui alla scheda di sicurezza allegata, descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento dello stesso.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per fare una presentazione ad un pubblico esteso?

Lorella Bortolato

Etanolo Assoluto

Formula: C_2H_6O
Peso molecolare: 46,07 g/mol
Proprietà chimico-fisiche
Densità (g/cm3, in c.s.) 0,789
Indice di rifrazione 1,3611 (293 K, 589 nm)
Costante di dissociazione acida a 298 K $1{,}26 \times 10{-}16$
Solubilità in acqua completa
Coefficiente di ripartizione 1-ottanolo/acqua -0.31
Temperatura di fusione −114,3 °C (158,8 K)
$\Delta_{fus}H^0$ (kJ·mol−1) 4,9
$\Delta_{fus}S^0$ (J·K−1mol−1) 31
Temperatura di ebollizione 78,4 °C (351,5 K)
$\Delta_{eb}H^0$ (kJ·mol−1) 38,56
Tensione di vapore (Pa) a 292,75 K 5730
Proprietà termochimiche
Δ_fH^0 (kJ·mol−1) −277,6
Δ_fG^0 (kJ·mol−1) −174,8
S^0_m(J·K−1mol−1) 160,7
$C^0_{p,m}$(J·K−1mol−1) 112,3
Proprietà tossicologiche
LD50 (mg/kg) Orale, ratto 10 470[1]
Indicazioni di sicurezza
Punto di fiamma 12 °C (285 K)
Temperatura di autoignizione 425 °C (698 K)

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2. Identificazione dei pericoli
2.1 Classificazione della sostanza o della miscela:
Classificazione ai sensi del Regolamento (CE) N. 1272/2008:
Pittogrammi:

Pericolo

2.2 Elementi dell'etichetta:
Etichettatura conforme al regolamento (CE) n. 1272/2008

Codici di indicazioni di pericolo:
H225
H319

Consigli di prudenza:

Generali P101 P102 Prevenzione P210	Reazione P370+P378 Conservazione P403+P235 Smaltimento P501

Chapter Five

Differential Thermal Analysis (DTA)

What Does This Technique Measure?

Differential Thermal Analysis (DTA) of a powder measures the temperature difference (ΔT) between the temperature at the center of a powder sample and the temperature at the center of a standard (inert) powder as both samples are heated and cooled (side-by-side) through a standard firing program.

By comparing the sample's temperature to the standard's temperature, the resulting DTA curves show *exothermic* and *endothermic* reactions (those that give off energy, shown as peaks, and those that take place in the sample as it is heated from room temperature to the firing temperature and cooled back again to room temperature.

Alumina is frequently used as the standard powder because it is *inert* over a wide range of temperatures. It is *inert* because it doesn't react with gases, decompose, nor go through any phase changes over the typical range of firing temperatures of most ceramic materials. As a result, alumina simply heats up at a relatively steady rate and provides an excellent, repeatable basis value for sample DTA measurements.

DTA analysis requires small samples (several grams) of dry powders. All powder and suspension samples must be thoroughly dried before performing analyses. DTA analyses are routinely used to

2. Ibid., pp. 60-61.

3. Funk, J.E., and Dinger, D.R., "Chapter 17 The Role of the Liquid Medium," Predictive Process Control of Crowded Particulate Suspensions Applied to Ceramic Manufacturing, pp. 199-210, Kluwer Academic Publishers, Boston, MA (1994).

4. *Ibid.*, "Chapter 43 Methylene Blue Index," pp. 668-689.

5. Phelps, G.W., Maguire, S.G., Kelly, W.J., and Wood, R.K., Rheology and Rheometry of Clay-Water Systems, United Clays, Inc., PO Box 111, Gleason, TN (no date given.)

6. Lopez, L.A., private communication (1992).

7. Mortaro, R.A., "A Photometric Method for the Determination of the Methylene Blue Index of Clays," unpublished work, Deca-Duratex Sanitaria S.A., Jundiai, SP, Brasil (1988).

Chapter Three

Mercury Porosimetry

What Does This Technique Measure?

Mercury porosimetry measures porosities and pore size distributions of porous materials. Since mercury does not wet ceramic materials, capillary action will not suck mercury into pore systems of ceramic bodies. Pressure is required to push the mercury into the pores. Monitoring the applied mercury pressure and the volume of mercury forced into the pore system, these instruments can measure the sizes of pore openings (calculated from the mercury pressure) and the volume of pores of those sizes (calculated from the mercury intrusion volume) present in samples in the analysis chamber. As mercury pressures rise, finer and finer pores can be analyzed.

Mercury porosimetry requires small samples (several cm^3) of porous bodies for analysis. Although this technique is generally used as a tool for research and development, it can be used as a routine test to check the maturity of fired wares.

Why Is Mercury Porosimetry Important?

Many ceramic wares have strict porosity requirements. Many are fired to zero porosity. Some ceramic wares which are used as filters, however, are designed to have very precisely controlled porosities, pore sizes, and continuous pore channels to produce desired permeabilities. Mercury intrusion porosimetry can measure porosities, pore sizes, and the nature of the open porosity in ceramic wares.

SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.3

1. Descrivere le principali caratteristiche tecniche e gli usi di un apparecchio per l'analisi termogravimetrica (DTA/TGA).
2. Sulla base delle caratteristiche dell'acetone di cui alla scheda di sicurezza allegata, descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento dello stesso.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per redigere un rapporto per lo smaltimento dei rifiuti di laboratorio?

Acetone

Formula: C_3H_6O
Peso molecolare: 58,08 g/mol

Proprietà chimico-fisiche

Densità (g/cm3, in c.s.)	0,79
Solubilità in acqua	completamente miscibile
Temperatura di fusione	−95,4 ° C (177,8 K)
$\Delta_{fus}H^0$ (kJ·mol−1)	5,7
$\Delta_{fus}S^0$ (J·K−1mol−1)	32,3
Temperatura di ebollizione	56,2 ° C (329,4 K)
$\Delta_{eb}H^0$ (kJ·mol−1)	31,3

Proprietà termochimiche

Δ_fH^0 (kJ·mol−1)	−248,4
S^0_m(J·K−1mol−1)	199,8
$C0_{p,m}$(J·K−1mol−1)	126,3

Indicazioni di sicurezza

Punto di fiamma	- 17 °C (256 K)
Limiti di esplosione	2,6 - 13%
Temperatura di autoignizione	540 ° C (831 K)

SEZIONE 2: Identificazione dei pericoli
2.1 Classificazione della sostanza o della miscela
Classificazione secondo il Regolamento (CE) n. 1272/2008
H225; H319; H336
Per quanto riguarda il testo completo delle indicazioni di pericolo menzionate in questo paragrafo, riferirsi al paragrafo 16.
Classificazione secondo le Direttive EU 67/548/CEE o 1999/45/CE
R11; R36; R66; R67
Per il testo completo delle frasi R menzionate in questa sezione, riferirsi alla sezione 16.
2.2 Elementi dell'etichetta
Etichettatura secondo il Regolamento (CE) n. 1272/2008
Pittogramma

Pericolo

Indicazioni di pericolo	Consigli di prudenza
H225 H319 H336	P210 P261 P305 + P351 + P338 Informazioni supplementari sui pericoli (EU) EUH066

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SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.2

1. Descrivere le principali caratteristiche tecniche e gli usi di uno spettrofotometro infrarosso (FT-IR).
2. Sulla base delle caratteristiche dell'acido solforico di cui alla scheda di sicurezza allegata, descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento dello stesso.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per fornire agli utenti le informazioni relative all'uso corretto di DPI?

Acido solforico

Formula: H_2SO_4
Peso molecolare: 98,09 g/mol
Proprietà chimico-fisiche

Densità (g/cm3, in c.s.)	1,84
Costante di dissociazione acida a 298 K	K1: ~ 10^5 K2: ~ 10^{-2}
Solubilità in acqua	completa con reazione esotermica
Temperatura di fusione	−15 ° C (258 K)
Temperatura di ebollizione	337 ° C (610 K)
Tensione di vapore (Pa) a 293 K	0,01

Proprietà termochimiche

$\Delta_f H^0$ (kJ·mol−1)	−814
$\Delta_f G^0$ (kJ·mol−1)	−690
S^0_m(J·K−1mol−1)	156,9
$C^0_{p,m}$(J·K−1mol−1)	138,9

SEZIONE 2: Identificazione dei pericoli
2.1 Classificazione della sostanza o della miscela
Classificazione secondo il Regolamento (CE) n. 1272/2008
H290; H314
Per quanto riguarda il testo completo delle indicazioni di pericolo menzionate in questo paragrafo, riferirsi al paragrafo 16.
Classificazione secondo le Direttive EU 67/548/CEE o 1999/45/CE
R35
Per il testo completo delle frasi R menzionate in questa sezione, riferirsi alla sezione 16.
2.2 Elementi dell'etichetta
Etichettatura secondo il Regolamento (CE) n. 1272/2008
Pittogramma

Pericolo

Indicazioni di pericolo
H290
H314

Consigli di prudenza
P280
P305 + P351 + P338
P310

Chapter Two

Surface Area Analysis

What Does This Technique Measure?

Surface area analyzers measure the total exposed surface area (m^2) present in powder samples. Surface area values are usually reported as either Specific Surface Area (SSA) which is the surface area in a fixed mass of particles (m^2/g) or as Volume specific Surface Area (VSA) which is the surface area in a fixed volume of particles (m^2/cm^3).

Surface area analysis requires small samples of dry powders (several grams) or particulate suspensions (several mL.) Surface area analysis is used both as a routine, daily, process control tool and as a research and development tool.

Why Are Surface Areas Important?

First and foremost, surface area is an important control parameter for the processing of ceramic bodies. Since chemical additives in ceramic suspensions and bodies interact with particle surfaces, control of surface area is a major contributor to the consistency of daily body properties. Relative to their masses, the finest particles contribute the greatest surface areas. When body surface areas vary widely from batch to batch, coverage densities and efficiencies of additives vary equally widely, and consistency of daily body processing properties will be difficult to achieve.

Most chemical additives in ceramic bodies affect interparticle repulsive and attractive forces in the interparticle fluid environment by

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SELEZIONE PUBBLICA N. 2020N27

Elenco di domande per colloquio orale n.1

1. Descrivere le principali caratteristiche tecniche e gli usi di uno spettrofotometro UV-Visibile.
2. Sulla base delle caratteristiche dell'acido acetico di cui alla scheda di sicurezza allegata, descrivere le procedure di sicurezza da adottare per l'utilizzo, stoccaggio e smaltimento dello stesso.

Valutazione conoscenze informatiche

- Quale programma utilizzerebbe per redigere le istruzioni per l'utilizzo di una apparecchiatura scientifica?

Lorella Bortolotti

Acido Acetico

Formula: H_3CCOOH
Peso molecolare: 60,05 g/mol
Punto di ebollizione: 118 °C (1013 hPa)
Punto di fusione: 17 °C
Densità: 1,05 g/cm³ (20 °C)
Flash Pt: 38,5 °C
Temperatura di stoccaggio: Ambiente

SEZIONE 2: Identificazione dei pericoli

2.1 Classificazione della sostanza o della miscela
Classificazione secondo il Regolamento (CE) n. 1272/2008
H226; H314
Per quanto riguarda il testo completo delle indicazioni di pericolo menzionate in questo paragrafo, riferirsi al paragrafo 16.
Classificazione secondo le Direttive EU 67/548/CEE o 1999/45/CE
R10; R35
Per il testo completo delle frasi R menzionate in questa sezione, riferirsi alla sezione 16.
2.2 Elementi dell'etichetta
Etichettatura secondo il Regolamento (CE) n. 1272/2008

Pittogramma

Pericolo

Indicazioni di pericolo
H226.
H314

Consigli di prudenza
P280
P305 + P351 + P338
P310

Particle Size Distribution Analysis

What Does This Technique Measure?

The purpose of particle size distribution analysis is to measure the quantities of particles contained in each size class in a powder sample. Most particle size analysis techniques define particle sizes by reporting equivalent spherical diameters (ESD). Particles are grouped into many narrowly defined size classes that cover the whole range of sizes. Quantities of particles in each size class are usually reported as mass or volume percentages.

Particle size analyses require several grams of dry powders or several milliliters of particulate suspensions. Particle size analyses are used both as routine, daily, process control tools and as research and development tools.

Why Are Particle Size Distributions Important?

Size distributions of particles in ceramic bodies are important because the shape of each distribution affects many properties of body slips, plastic forming bodies, green, dry, and fired wares, as well as many drying and firing properties.

For example, particle packing densities are a function of the total particle size distribution of each body's ingredient powders. Packing densities directly affect viscosities and rheologies of suspensions, porosities, pore size distributions, and permeabilities of