

Name and Surname: Fabio Zaza

Qualification: Researcher

Scientific Sector: Chemistry

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Biography:

DOCTORATE THESIS

1. Sintesi e caratterizzazione di materiali anodici alternativi per celle a combustibile alimentate con biogas, **F.Zaza**, Tesi di Dottorato in Ingegneria dei Materiali e della Materie Prime, XXIII ciclo (2011), Roma.

PATENTS

2. Procedimento Termochimico per la Produzione di Rivestimenti Ceramici Protettivi su Acciai Inossidabili., S.Frangini, A.Masci e **F.Zaza**, brevetto ENEA N°RM2010A000583, data di deposito: 04.11.2010

PAPERS WITH ISI INDEX

3. Degradation behavior of a commercial 13Cr ferritic stainless steel (SS405) exposed to an ambient air atmosphere for IT-SOFC interconnect applications, S.Frangini, A.Masci, S.J.McPhail, T.Soccio and **F.Zaza**, Materials Chemistry and Physics, vol.144 (3), 2014, p.491-497.
4. Purification of nickel or cobalt ion containing effluents by electrolysis on reticulated vitreous carbon cathode, A.Dell'Era, M.Pasquali, C.Lupi and **F.Zaza**, Hydrometallurgy, vol.150, 2014, p.1-8.
5. Temperature-independent sensors based on perovskite-type oxides, **F.Zaza**, S.Frangini, J.Leoncini, I.Luisetto, A.Masci, M.Pasquali, S.Tuti, AIP Conference Proceedings, vol.603, 2014, p.53-61.
6. Perovskite synthesis via complex sol-gel process to immobilize radioactive waste elements, T.Smoliński, A.Deptuła, T.Olczak, W.Łada, M.Brykała, P.Wojtowicz, D.Wawszczak, M.Rogowski and **F.Zaza**, Journal of Radioanalytical and Nuclear Chemistry, vol.299 (1), 2014, p.675-680.
7. Innovative nanomaterials for fuel cells fed with biogas, **F.Zaza**, M.Pasquali, E.Simonetti, C.Paoletti, A.Dell'Era, Il Nuovo Cimento Colloquia, Vol.36 (2), 2013, p.73.
8. Synthesis and characterization of TiO₂ nanotubes as anodic material in lithium-ion batteries, A.Dell'Era, F.Mura, M.Pasquali, A.Pozio and **F.Zaza**, Il Nuovo Cimento Colloquia, vol.36 (2), 2013, p.65.
9. Electrochemical Impedance Study of the Poisoning Behaviour of Ni-based Anodes at Low Concentrations of H₂S in an MCFC, H.Devianto, E.Simonetti, S.J.McPhail, **F.Zaza**, V.Cigolotti, C.Paoletti, A.Moreno, A.LaBarbera and I. Luisetto, International Journal of Hydrogen Energy (Impact Factor 4.1), vol.37 (24), 2012, Pages 19312-19318.
10. Molten Carbonate Corrosion of a 13-Cr Ferritic Stainless Steel Protected by a Perovskite Conversion Treatment: Relationship with the Coating Microstructure and Formation Mechanism, S.Frangini, **F.Zaza** and A.Masci, Corrosion Science (Impact Factor 3.4), vol.62, 2012, pp.136–146.
11. Vitrification of Nuclear Wastes by Complex Sol-Gel Process, A.Deptuła, M.Miłkowska, W.Łada, T.Olczak, D.Wawszczak, T.Smoliński, M.Brykała, A.G.Chmielewski, **F.Zaza** and K.C.Goretta, Advanced Materials Research (Impact Factor 0.2), Vol.518-523, 2012, pp.3216-3220

12. Molten Salt Synthesis of Perovskite Conversion Coatings: a Novel Approach for Corrosion Protection of Stainless Steels in Molten Carbonate Fuel Cells, S.Frangini, A.Masci and **F.Zaza**, Corrosion Science (Impact Factor 3.3), vol.53, 2011, pp.2539–2548.
13. Multiple Regression Analysis of Hydrogen Sulphide Poisoning in Molten Carbonate Fuel Cells Used for Waste-to-Energy Conversions, **F.Zaza**, C.Paoletti, R.LoPresti, E.Simonetti and M.Pasquali, International Journal of Hydrogen Energy (Impact Factor 4.1), vol.36, 2011, pp.8119–8125.
14. Studies on Sulfur Poisoning and Development of Advanced Anodic Materials for Waste-to-Energy Fuel Cells Applications, **F.Zaza**, C.Paoletti, R.LoPresti, E.Simonetti and M.Pasquali, Journal of Power Sources (Impact Factor 3.8), vol.195, 2010, pp.4043-4050
15. Molten Carbonate Fuel Cells Fed with Biogas: Combating H₂S, R.Ciccoli, V.Cigolotti, R.LoPresti, E.Massi, S.J.McPhail, G.Monteleone, A.Moreno,V.Naticchioni, C.Paoletti, E.Simonetti, **F.Zaza**, Waste Management (Impact Factor 2.4), vol.30, 2010, pp.1018–1024
16. Performance study of Nickel Covered by Lithium Cobaltite cathode for MCFC: a comparison in Li/K and Li/Na carbonate melts, C.Paoletti, F.Zaza, R.LoPresti, M.Carewska and E.Simonetti, Journal of Fuel Cell Science and Technology (Impact Factor 1.2), vol.7, 2010,pp.021008-1 – .021008-5
17. Characterization of Gas Diffusion Electrodes for Polymer Electrolyte Fuel Cells, A.Pozio, A.Cemmi, M.Carewska, C.Paoletti, F.Zaza and E.Senna, Journal of Fuel Cell Science and Technology (Impact Factor 1.2), vol.7, 2010, pp.041003-1 – 041003-7
18. Performance Analysis of New Cathode Materials for Molten Carbonate Fuel Cells, C.Paoletti, M.Carewska, R.LoPresti, S.McPhail, **F.Zaza**, Journal of Power Sources (Impact Factor 3.8), vol.193, 2009, pp.292–297
19. Bipolar Plate Materials for PEMFCs: A Conductivity and Stability Study, A.Pozio, **F.Zaza**, A.Masci, R.F.Silva, Journal of Power Sources (Impact Factor 3.8), vol.179, 2008, pp.631-639

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20. Sol-Gel Processing of Silica Nuclear Waste Glasses, A.Deptuła, M.Milkowska, W.Lada, T.Olczak, D.Wawszczak, T.Smolinski, **F.Zaza**, M.Brykała, A.G.Chmielewski, K.C.Goretta, New Journal of Glass and Ceramics, vol.1, 2011, pp.105-111
21. Anti-Corrosion Methods for Fuel Cell Metal Bipolar Plates: A Review of Recent Patent Literature, S.Frangini and **F.Zaza**, Recent Patents on Corrosion Science, vol.1, 2011, pp.93-107
22. Synthesis of Perovskite by Complex Sol-Gel Process for Nuclear Waste Immobilization, T.Smoliński, A.Deptuła, T.Olczak, W.Łada, D.Wawszczak, M.Brykała, **F.Zaza**, A.G.Chmielewski, Institute of Nuclear Chemistry and Technology Annual Report (2011), **ISSN1425-204X**, pp.51-53.
23. Solutions for Material Corrosion Problems in MCFC, S.Frangini, A.Moreno and F.Zaza, Advances in Science and Technology Vol. 72 (2010) pp 291-298
24. Novel sol-gel synthesis of LiMn₂O₄ and LiNi_xCo_{1-x}O₂ powders, A.Deptula, W.Lada, T.Olczak, D.Wawszczak, M.Brykała, F.Zaza and K.C.Goretta, Advances in Science and Technology Vol. 63 (2010) pp 14-23
25. Sviluppo e caratterizzazione di anodi per celle a combustibile a carbonati fusi resistenti all'avvelenamento da idrogeno solforato presente nel gas di alimentazione, E. Simonetti, H. Devianto, F. Zaza, Rapporto RICERCA SISTEMA ELETTRICO (2010) Report Report RdS/2011/269
26. Effetto delle composizioni del gas anodico sulle prestazioni di cella MCFC e sviluppo di nuovi anodi alternativi, E.Simonetti, R.LoPresti, C.Paoletti, **F.Zaza**, Rapporto RICERCA SISTEMA ELETTRICO (2010) Report RdS/2010/164

27. WO₃-ZrO₂ Gel Nanocomposites as Potential Catalysts for the Isomerization Process of Hydrocarbons, E.Iller, D.Wawszczak, A.Deptula, W.Lada, **F.Zaza**, Institute of Nuclear Chemistry and Technology Annual Report (2010), **ISSN1425-204X**, pp.58-60.
28. Vitrification of Nuclear Wastes by Complex Sol-Gel Process, A.Deptula, M.Milkowska, W.Lada, T.Olczak, **F.Zaza** and A.G.Chmielewski, Institute of Nuclear Chemistry and Technology Annual Report (2010), **ISSN1425-204X**, pp.48-49.
29. Synthesis of LiMn₂O₄ and LiNi_xCo_{1-x}O₂ by Complex Sol-Gel Process, A.Deptula, W.Lada, T.Olczak, D.Wawszczak, M.Brykala, **F.Zaza**, K.C.Goretta, Institute of Nuclear Chemistry and Technology Annual Report (2009), **ISSN1425-204X**, pp.42-46
30. An Innovative Salt for Lithium-Polymer Batteries, G.Appetecchi, **F.Zaza**, D.Zane and B.Scrosati, Energia, Ambiente,e Innovazione, vol.4 (2009), pp.55-67.
31. Studio dei meccanismi di avvelenamento della cella da parte delle impurezze a base di zolfo. Studio e messa a punto di nuovi componenti di cella più tolleranti allo zolfo. Caratterizzazione mediante analisi termica degli elementi per MCFC prodotti da FN, E.Simonetti, M.Carewska, R.LoPresti, C.Paoletti, S.McPhail, **F.Zaza**, Rapporto RICERCA SISTEMA ELETTRICO (2009) RSE/2009/170
32. Synthesis and Testing of Gel Metal-Oxide Composites as Filling Materials for 188W/188Re Generator Columns E.Iller, A.Deptula, **F.Zaza**, W.Lada, T.Olczak,D.Wawszczak, M.Brykala, Institute of Nuclear Chemistry and Technology Annual Report (2008), **ISSN1425-204X**, pp.102-105

PROCEEDINGS WITH FULL-PAPERS OR EXTENDED-ABSTRACTS

33. Nuclear Waste Immobilization into Structure of Zirconolite, T.Smoliński, A.Deptula, W.Lada, T.Olczak, A.G. Chmielewski and F.Zaza (Full Paper), MRS Proceedings, Cambridge University Press, vol.1683, Symposium S, 2014, p.1-6
34. Metallic Interconnectors for Intermediate Temperature Solid Oxide Fuel Cell, F.Zaza, S.Frangini, A.Masci, T.Soccio, 5th edition of the "European Fuel Cell Technology & Applications Piero Lunghi Conference", **ISBN: 978-88-8286-297-8**, 11-13 December 2013 Rome, Italy, EFC13205.
35. Comparative Assessment of Integrated Systems for Bioenergy Production by Fuel Cell Devices: Environmental Aspects, F.Zaza, G.Barberio, D.Ciarla and M.Pasquali, 5th edition of the "European Fuel Cell Technology & Applications Piero Lunghi Conference", **ISBN: 978-88-8286-297-8**, 11-13 December 2013 Rome, Italy, EFC13207.
36. Computational Analyses Of Solid Oxide Fuel Cell, F.Zaza, S.Frangini, T.Soccio, 5th edition of the "European Fuel Cell Technology & Applications Piero Lunghi Conference", **ISBN: 978-88-8286-297-8**, 11-13 December 2013 Rome, Italy, EFC13206.
37. Anode Materials For Fuel Cells Fed With Biogas, **F.Zaza**, M.Pasquali, E.Simonetti, C.Paoletti (Full Paper), AICIng 2012, **ISBN 978-88-7051-226-7**, 16-19 September 2012, Catania, Italy
38. Synthesis of perovskite (CaTiO₃, component of SYNROC C) by complex sol gel process for nuclear waste immobilization, T Smolinski, A Deptula, T Olczak, W Lada, AG Chmielewski and **F Zaza**, Nuclear For Fuel Cycle Conference, 23-25 April 2012, Manchester, United Kingdom.
39. Impact of H₂S on Molten Carbonate Fuel Cell Fed with Biogas: Effect of Ceria and Zirconia addition to Ni-Cr Traditional Anode, E.Simonetti, H.Devianto, **F.Zaza**, I.Luisetto and D.Fabbri, 4th edition of the "European Fuel Cell Technology & Applications Piero Lunghi Conference", **ISBN: 978-88-8286-254-1**, pp.101-102, 14-16 December 2011 Rome, Italy,
40. Solutions for Material Corrosion Problems in MCFC, S.Frangini, A.Moreno and **F.Zaza** (Full Paper), 5th Forum on New Materials, CIMTEC2010, 13-18 Giugno 2010 Montecatini, Italy.
41. Novel Sol-Gel Synthesis of LiMn₂O₄ and LiNi_xCo_{1-x}O₂ Powders, A.Deptula, W.Lada, T.Olczak, D.Wawszczak, M.Brykala, **F.Zaza** and K.C.Goretta (Full Paper), 12th International Ceramic Congress, CIMTEC2010, 6-11 Giugno 2010, Montecatini, Italy.

42. Molten Carbonate Fuel Cell Fed With Biogas, **F.Zaza**, C.Paoletti, R.LoPresti, E.Simonetti, M.Pasquali (Full Paper), 18th European Biomass Conference and Exhibitions from research to Industry and Markets, **ISBN 978-88-89407-56-5**, 3-7 Maggio 2010, Lione, Francia.
43. All-round experimental analysis of H₂S effects on a single MCFC in laboratory conditions, V.Cigolotti, R.LoPresti, S.McPhail, A.Moreno, C.Paoletti, E.Simonetti, **F.Zaza** (Extended Abstract), S. Pil Yoon, S. Woo Nam, T.-H. Lim, 3rd European Fuel Cell Technology and Applications Conference - Piero Lunghi Conference, **ISBN 978-88-8286-211-4**, pp.351-352, 15-18 Dicembre 2009, Roma, Italia
44. Sulphur-Tolerant Anode for MCFC Fed with Biogas, **F.Zaza**, V.Cigolotti, R.LoPresti, S.McPhail, C.Paoletti, E.Simonetti, M.Pasquali ((Extended Abstract), 3rd European Fuel Cell Technology and Applications Conference - Piero Lunghi Conference, **ISBN 978-88-8286-211-4**, pp.127-128, 15-18 Dicembre 2009, Roma, Italia
45. Molten Carbonate Fuel Cell Fed with Biogas from Anaerobic Digestion: Investigation of the Fate of H₂S, V.Cigolotti, E.Massi, R.LoPresti, S.J.McPhail, A.Moreno, C.Paoletti, E.Simonetti, **F.Zaza** (Full Paper), 17th European Biomass Conference and Exhibition 2009 - From Research to Industry and Markets, **ISBN 978-88-89407-57-3**, 29 Giugno – 3 Luglio 2009, Amburgo, Germania.
46. Studio dell'avvelenamento da zolfo e sviluppo di materiali anodici alternativi per celle a combustibile alimentate con biogas, **F.Zaza**, New Energy Frontiers II, Congresso internazionale sull'energia, 17-19 Giugno 2009, Gaeta, Italia.
47. Ricerca e sviluppo di materiali alternativi per celle a combustibile a carbonati fusi, **F.Zaza**, M.Carewska, R.LoPresti, S.McPhail, C.Paoletti and E.Simonetti, New Energy Frontiers II, Congresso internazionale sull'energia, 17-19 Giugno 2009, Gaeta, Italia.
48. Bioenergy from Fuel Cells: Effects of Hydrogen Sulfide Impurities on Performance of MCFC Fed with Biogas, **F.Zaza**, C.Paoletti, R.LoPresti, E.Simonetti and M.Pasquali, International Conference on Fundamentals and Developments of Fuel Cell, **ISBN 978-2-7466-0413-1**, 10-12 December 2008, Nancy, Francia.
49. Molten Carbonate Fuel Cell fed with biogas: overview and preliminary experimental investigation, 2nd International Symposium on Energy from Biomass and Waste, V.Cigolotti, R.LoPresti, S.J.McPhail, A.Moreno, C.Paoletti, E.Simonetti, **F.Zaza**, 17-20 November 2008, Venezia, Italia.
50. Characterization of GDE for Polymer Electrolyte Fuel Cells, A.Pozio, A.Cemmi, M.Carewska, C.Paoletti, **F.Zaza**, E.Senna, European Fuel Cell Technology and Applications Conference, **ISBN 0-7948-4801-9**, 11-14 Dicembre 2007 Roma, Italia
51. Investigation on hydrogen sulphide poisoning in molten carbonate fuel cells used for waste-to-energy conversion, **F.Zaza**, C.Paoletti, R.LoPresti, E.Simonetti and M.Pasquali (Full Paper), 3rd World Congress of Young Scientists on Hydrogen Energy Systems 7-9 Ottobre, 2009, Torino, Italia.

PROCEEDINGS WITH SHORT ABSTRACT

52. Gas sensor based on perovskite oxide nanotubes, **F.Zaza**, M.Pasquali, G.Orio, E.Serra, A.Dell'Era, F.Mura, F.Scaramuzzo, X Edition Nanoforum, 22–25 September 2014, Rome, Italy.
53. Hybrid perovskite halides, **F. Zaza**, M. Pasquali, G.Corda, E. Serra, M.Tucci, X Edition Nanoforum, 22–25 September 2014, Rome, Italy.
54. Synthesis of Nanomaterials for Gas Sensor Devices, **F. Zaza**, M. Pasquali, V. Pallozzi, E. Serra, S.Frangini, X Edition Nanoforum, 22–25 September 2014, Rome, Italy.
55. Nanostructured perovskite-based gas-sensors for combustion processes development and environmental prevention, S.Frangini, J.Leoncini, I.Luisetto, A.Masci, M.Pasquali, S.Tuti, **F.Zaza**, IX Edition Nanoforum, 18–20 September 2013, Rome, Italy

56. Synthesis of perovskite doped Sr, Co, Cs and Nd by complex Sol-Gel process, T.Smolinski, A.Deptula, W.Lada, D.Wawszczak, M.Brykała, T.Olczak, **F.Zaza**, XVII International Sol-Gel Conference, 25-30 August 2013, Madrid, Spain.
57. Complex Sol-Gel process (CSGP) synthesis of WO₃ (doped ZrO₂, TiO₂, SiO₂) nanocomposites as filling materials for W-188/Re-188 generator columns, D.Wawszczak, A.Deptula, T.Olczak, W.Lada, H.Polkowska-Motrenko, M.Brykała, E.Iller, **F.Zaza**, XVII International Sol-Gel Conference, 25-30 August 2013, Madrid, Spain
58. Nanostructured coating layer for anode materials in fuel cell fed with biogas, **F.Zaza**, M.Pasquali, E.Simonetti, C.Paoletti, VIII Edition Nanoforum, 24–26 September 2012, Rome, Italy (invited speaker)
59. Synthesis and characterization of TiO₂ nano-tubes as anodic material in Lithium-ion batteries, A. Dell'Era; F. Mura; M. Pasquali; A. Pozio; **F. Zaza**, VIII Edition Nanoforum, 24–26 September 2012, Rome, Italy
60. Composite materials for molten carbonate fuel cell anodes, **F.Zaza**, H.Devianto, C.Paoletti, E.Simonetti, European Fuel Cell Forum, 28 June – 1 July 2011 Lucerne, Switzerland
61. Surface characterization of Ni-based anode after poisoning with low concentration of H₂S in MCFC, H.Devianto, **F.Zaza**, E.Simonetti, A.LaBarbera, European Fuel Cell Forum, 28 June – 1 July 2011 Lucerne, Switzerland
62. Challenges in Electrochemical Bio-Energy Conversion: Effects of Biogas Impurities on Fuel Cell Performance, **F.Zaza**, C.Paoletti, R.Lopresti, E.Simonetti, M.Pasquali, First European Energy Conference, 19-23 Aprile 2010, Barcellona, Spagna.
63. Vitrification of nuclear wastes by a complex sol-gel process, A.Deptula, M.Milkowska,W.Lada, T.Olczak, **F.Zaza**, A.G.Chmielewski, 1st ACSEPT International Workshop, 31 Marzo – 2 Aprile 2010, Lisbona, Portogallo.
64. The Effect of H₂S on the Molten Carbonate Fuel Cell (MCFC), V.Cigolotti, R.LoPresti, S.McPhail, A.Moreno, C.Paoletti, E.Simonetti, **F.Zaza**, International Workshop on the Effects of Fuel & Air Quality to the Performance of fuel cells, 9-11 Settembre 2009, Berlino, Germania.
65. Current interruption: a method to characterize a 100 cm² class molten carbonate fuel cell, , R. Lo Presti, C. Paoletti, S. Mc Phail, , E. Simonetti, **F. Zaza**, International Symposium on Diagnostics Tools for Fuel Cell Technologies 23-24 Giugno 2009, Trondheim, Norway.
66. Festival dell'Energia - l'Energia Spiegata: Fuel Cell in the Waste to Energy Chain (lavoro a stampa ENEA), Lecce, Italia, 14-17 Maggio 2009. Contributo per la stesura del capitolo: Molten Carbonate Fuel Cell –MCFC
67. Performance analysis of new cathode materials for molten carbonates fuel cells, E.Simonetti, M.Carewska, C.Paoletti, R.LoPresti, S.McPhail, **F.Zaza**, Fuel Cell Science and Technology 2008 Scientific Advances in Fuel Cell Systems, 8-9 Ottobre 2008, Copenhagen, Danimarca,
68. Preparation and structure analysis of gel-metal oxide composites as filling materials for W-188/Re-188 generator columns, E.Iller, A.Deptula, J.Milczarek, J.Zoladek, L.Gorski and **F.Zaza**, 11th European Powder Diffraction Conference, 19-22 Settembre 2008, Vasavia, Polonia
69. Gel Metal-Oxide Composites as Filling Materials for W-188/Re-188 Generator Columns, E.Iller, H.Polkowska-Motrenko, A.Deptula, D.Wawszczak, W.Lada, M,Konior, J.Milczarek, J.Zoladek, **F.Zaza**, International Conference on Recent Development and Applications of Nuclear Technologies, 15-17 Settembre 2008 Bialowieski, Polonia
70. Novel Sol-Gel Synthesis with Controlled Self-Ignition Step of LiMn₂O₄ and LiNi_xCo_{1-x}O₂, A.Deptula, W.Lada, T.Olczak, D.Wawszczak, M.Brykała, **F.Zaza**, K.Goretta, International Conference on Sol-Gel Materials, 1-5 Giugno 2008, Trzebieszowice, Polonia,

Title of teaching module:

LABORATORY OF ANALYTICAL CHEMISTRY

Description of teaching module (teaching program):

CLASSROOM PROGRAMME

Introduction

Central role of analytical chemistry; steps in chemical analysis; classification of analytical techniques; basic theory behind electromagnetic spectroscopy, mass spectrometry, electrochemical techniques, thermal analysis and chromatography.

Units and measurements

Fundamental SI units; derived SI units; factors for conversion to SI units; mechanical balances: equal-arm and single-pan balances; Electrical Balances; errors in mass measurement; steps in analyte weighing; volumetric glassware; Errors in volume measurement; mole; concentrations: molar fraction, mass percentage, molarity, molality, normality; standard solutions.

Errors in Analytical Chemistry

The central tendency of collected numbers: arithmetic mean, harmonic mean, geometric mean, median, mode; population mean and sample mean; Accuracy and precision; Absolute and relative error; Standard deviation and variance; Pooled Standard deviation; Systematic error: sources, categories, detection; Random error: Gaussian curve, confidence level and confidence interval; Gross error; Significant digits; Error propagation; Statistical hypothesis testing: t-test, F-test, Q-test; Calibration Methods: conventional method, standard addition method, internal standard method.

Fundamentals of Chemistry

Thermodynamics: zeroth, first second and third law; Thermochemistry; State functions: internal energy, enthalpy, entropy, Gibbs free energy; Standard State; Dependence of Gibbs Free Energy on Temperature and pressure; Chemical potential; Free energy of reactions; Concentration equilibrium constant and equilibrium composition; Dependence of Equilibrium constant and equilibrium composition on thermodynamics factors: Van't Hoff Law and Le Chatelier Principle; Chemical kinetics: molecularity, Rate equations, orders of reaction, activation Energy and rate constant; Arrhenius equation.

Acid-Base titration

Definitions of acid and base: Arrhenius, Bronsted and Lowry, Lewis; Acid, Base and Anfoteric; pH Definition; Buffer solution; Calculating pH: systematic approach schematic approach; septicistic approach; graphical approach; Calculating Acid-Base Titration Curves; Indicators. (Acid-Base solutions under studying: strong OR weak monoprotic acid, strong acid AND strong base, weak acid AND strong base, strong OR weak diprotic acid; semiweak diprotic acid; strong acid and weak acid; acid strength dependence on concentration; Anphoteric; Salt solutions under studying: salt from strong acid AND strong base, salt from weak acid AND strong base, salt from strong acid AND weak base, salt from weak acid AND weak base; Solution of weak acid AND salt with common anion)

Complexometric titration

Formation constant; Overall formation constant; Fraction of the complexed metal; Fraction of the unprotonated legand; Conditional formation constant; EDTA; Calculating complexometric titration curves; Error due to the basic conditions; Indicators.

Activity

Hydrated ions; Ionic atmosphere; Ionic strength; Definition of activity; Activity coefficient; Thermodynamic equilibrium constant; relationship between Thermodynamic equilibrium constant and concentration equilibrium constant; Calculating pH without neglecting the ionic strength effects.

Precipitation titration

Dissolution reactions; Solubility product; Solubility; Precipitates formation: nucleation and particle growth; Dependence of the precipitates size on supersaturation; Coagulation due to the electrical double layer; Precipitation from homogeneous solution technique; Precipitates purity; Weight and precipitation titrimetry; Indicators: Cromate ion, Iron III ion, Fluorescein; Calculating precipitation titration curves.

LABORATORY PROGRAMME

LAB1_Standardization of HCl solution

Prepare the titrand solution by diluting a mother solution of HCl. Prepare the titrant solution by dissolving a specific weighted mass of Na_2CO_3 (primary standard). Determinate the concentration of HCl by performing the titration. From three titrations, calculate the mean and the experimental error.

LAB2_Determination of Carbonate

Prepare the titrand solution by dissolving a weighted mass of the powder sample. Determinate the percentage of sodium carbonate into the unknown powder mixture from each titration experiment, using HCl standard solution as titrant. From three titrations, calculate the mean and the experimental error.

LAB3_Standardizzation of NaOH solution

Prepare the titrand solution by dissolving a specific weighted mass of NaOH pearls. Prepare the titrant solution by dissolving a specific weighted mass of $\text{KHC}_8\text{H}_4\text{O}_4$ (primary standard). Determinate the concentration of NaOH by performing the titration. From three titrations, calculate the mean and the experimental error.

LAB4_Determination of Phosphoric acid

Prepare the titrand solution by diluting the sample into a volumetric flask (matraccio). Determinate the amount (grams) of phosphoric acid into the sample from each titration experiment, using NaOH standard solution as titrant and a measured aliquot of the titrand solution. From three titrations, calculate the mean and the experimental error.

LAB5_Standardizzation of AgNO_3 solution

Prepare the titrant mother solution by dissolving a specific weighted mass of NaCl into a volumetric flask (matraccio). Determinate the concentration of AgNO_3 mother titrand solution from each titration experiment. From three titrations, calculate the mean and the experimental error.

LAB6_Determination of NaCl

Prepare a diluted titrant solution by delivering a measured volume of AgNO_3 mother solution into a volumetric flask (matraccio). Prepare the diluted titrand solution by diluting the unknown solution. Determinate the amount (grams) of NaCl into the sample from each titration experiment, using AgNO_3 diluted standard solution as titrant and diluted unknown solution as titrand. From three titrations, calculate the mean and the experimental error.

LAB7_Standardization of EDTA solution

Prepare the titrand solution by dissolving a specific weighted mass of EDTA and adding an aliquot of previously prepared Mg-EDTA equimolar solution. Prepare the titrant solution by dissolving a specific weighted mass of CaCO₃ (primary standard). Determine the concentration of EDTA by performing the titration. From three titrations, calculate the mean and the experimental error.

LAB8_ Determination of Calcium

Prepare the titrand solution by dissolving a weighted mass of the powder sample and adding an aliquot of previously prepared Mg-EDTA equimolar solution. Determine the percentage of calcium carbonate into the unknown powder mixture from each titration experiment, using EDTA standard solution as titrant. From three titrations, calculate the mean and the experimental error.

SUGGESTED TEXTBOOK

Fundamentals of Analytical Chemistry (Skoog, West, Holler, Couch)