



Growing
ideas
through
networks

COST Action CA18202 – NECTAR

Network for Equilibria and Chemical Thermodynamics Advanced Research



Funded by
the European Union



NECTAR CA18202

Network for Equilibria and Chemical Thermodynamics Advanced Research COST ACTION 18202



The thermodynamic study of chemical equilibria represents the core of many important branches of chemistry. Coordination and supramolecular chemistry, chemical speciation, molecular modelling, drug design are just few examples.

The importance of chemical equilibria, and chemical thermodynamics in general, results from the simple assertion that many properties of elements and compounds depend mainly on their interactions in a given system: the biological activity of an element or molecule, or their environmental impact can be explained by a detailed study of these interactions, whose nature and strength can be evaluated by chemical equilibrium and other thermodynamic studies. For example, speciation modelling based on chemical equilibrium data is commonly used in to improve commercial products performances, investigate the mobility of pollutants and toxicants in the environment, optimize industrial processes, explain the mechanisms of action of biologically active substances. Furthermore, advanced thermodynamic studies yield deeper insights into the mechanisms of these interactions.

NECTAR will combine the expertise of the large community of specialists working in this field, creating a network based on the stimulating collaboration between them, promoting knowledge exchange, and achieving high technological progress. All this will be accomplished through a fruitful collaboration between young researchers and experienced scientists, taking into consideration gender balance and maximal geographical distribution. Innovative and integrated theoretical and experimental approaches will be established and optimized.

Overall, the outstanding quality of obtained results will serve as benchmark for next decades, allowing their application in the above-mentioned fields and substantially impacting on life quality of next generations.

<https://www.cost.eu/actions/CA18202/>

<https://www.cost-nectar.eu/>



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Network for Equilibria and Chemical Thermodynamics Advanced Research
COST ACTION 18202



Main Aim / Objective of the Action:

Provide a scientific and technological platform to gather together, under a unique network, a critical mass of European research groups with a strong expertise in chemical equilibria with industrial stakeholders, with the valuable reinforcement of international partners and European enterprises.

<https://www.cost.eu/actions/CA18202/>

<https://www.cost-nectar.eu/>



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Objectives of the Action:

Give response to actual scientific and technological challenges. In the wide field of equilibrium thermodynamics, particular attention will be paid to four specific areas: i) biology and medicine; ii) environmental science; iii) technology and industry; iv) modelling and software development.

Develop new technologies. The multidisciplinary and diversity of expertise within NECTAR will bring about a demand for developing new technological solutions, which will successfully combine all stakeholders' interests.

Identify new industrial stakeholders and applications. One of NECTAR's aims is to enlarge the perception about the potential of the use of different thermodynamic studies on specific industrial and technological applications (including environmental and biological/medical).

Promoting mobility and multidisciplinary training between the different participants of the Action.

Transferring knowledge and promoting industrial awareness.

Supporting a high proportion of ECIs, ITCs and assuring gender balance in the COST Action.

Promoting the sustainability of the network beyond the Action.

<https://www.cost.eu/actions/CA18202/>

<https://www.cost-nectar.eu/>



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Fact Sheet

Start of Action: 02/10/2019

End of Action: 01/04/2024

31 Member Countries (19 ITC)

249 Active Participants (~ 55% female, ~ 30% ECI)

Working Groups:

WG1 NECTAR for highly hydrolysable (HHC) and/or low-valence state (LVC) cations

WG2 NECTAR for strong and/or multifunctional ligands, macromolecules, polyelectrolytes

WG3 NECTAR for multicomponent solutions and complex matrices

WG4 NECTAR tools, services and facilities

WG5 NECTAR for the future: new trends and exploitation of results

<https://www.cost.eu/actions/CA18202/>

<https://www.cost-nectar.eu/>



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WG1

Main outcomes:

Development and testing of recommended procedures for the accurate determination of stability constants for some selected systems:

- Online release of guidelines on Cu(I) thermodynamic studies.
- Online release of guidelines on Fe(II) thermodynamic studies.

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WG-1
NECTAR for highly hydrolysable
(HHC) and/or low-valence state
(LVC) cations



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WG1 - NECTAR for highly hydrolysable (HHC) and/or low-valence state (LVC) cations has prepared the recommendations for working with copper(I) ions in aqueous solution. This work is related to the task of WG1 defining the most appropriate and accurate procedures and experimental approaches for the study of the solution speciation of LVC (e.g., Fe(II), Sn(II), Cu(I)).

The NECTAR recommendations for solution studies with copper(I) ions in aqueous media

All reagents should be of the highest purity and all laboratory vessels should be acid washed in 1 M HCl (or HNO₃) and subsequently rinsed with 18.2 MΩ·cm (or 0.1 μS·cm⁻¹) Milli-Q water to minimize trace metal contamination. When preparing buffers, it is recommended to pass the buffer stock solutions through a Chelex-100 ion exchange resin to remove trace metal impurities.

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WG-1
NECTAR for highly hydrolysable
(HHC) and/or low-valence state
(LVC) cations



Bartosz Orzeł, Valentyn Dzyhovskiy, Kamila Stokowa-Sołtys, Elżbieta Gumienna-Kontecka
University of Wrocław, Poland

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University of Szeged, Hungary

WG1 - NECTAR for highly hydrolysable (HHC) and/or low-valence state (LVC) cations has prepared the recommendations for working with iron(II) ions in aqueous solution. This work is related to the task of WG1 defining the most appropriate and accurate procedures and experimental approaches for the study of the solution speciation of LVC (e.g., Fe(II), Sn(II), Cu(I)).

The NECTAR recommendations for solution studies with Fe(II) ions

Due to the high susceptibility of Fe(II) ions to oxidation under atmospheric conditions, it is strongly advised to conduct all experiments involving Fe(II) ions in degassed & deoxygenated solvents and under anaerobic conditions.

• Deoxygenated solvents

It is recommended to prepare the solvent one day in advance (by heating ultra-pure (Milli-Q) water in a round-bottom flask for approximately 30 minutes at normal/reduced pressure and then bubbling argon gas through the liquid, and store the solution in a glove box until the next day.

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WG2

Main outcomes:

Development and testing of recommended procedures for the accurate determination of stability constants for some selected systems:

- Guidelines and recommended procedures for potentiometric measurements of strong ligand/metal interactions.
- Guidelines and recommended procedures for DNA interaction studies

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WG-2
NECTAR for strong and/or multifunctional ligands, macromolecules, polyelectrolytes

31 March 2024

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University of Debrecen, Hungary

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University of Valencia, Spain

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Univerita Karlova (Charles University Prague), Czech Republic

Recommended procedures for potentiometric determination of equilibrium constants of polydentate ligands and their metal ion complexes

<u>Content:</u>	<u>Page</u>
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1.1 Materials and stock solutions	
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1.1.3 Water	6
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Interaction with DNA – Guidelines, with a particular focus on fluorescence titrations

AUTHORS: Members of WORKING GROUP 2 (WG2 - Studies on strong and/or multifunctional ligands, macromolecules, polyelectrolytes) TASK GROUP 2 (TG2 – DNA BINDING)*

1 - INTRODUCTION

Within the wider aim of the NECTAR project and network, working group two on strong and/or multifunctional ligands, macromolecules, polyelectrolytes (WG2-TG2) is devoted to DNA. WG2-TG2 identified a target system for studies as validation standard. WG2-TG2 started by concentrating on the dye/DNA interaction producing the higher signal changes and, therefore, the most suitable for v ("golden standard") system was chosen based on reactants' stability and c handling. The different research groups performed tests for the target system guidelines on how to perform experiments. The aim is the development and procedure. Some of the suggestions expressed in this document are intended document is focused on and is especially devised for **fluorescence titrations**.

To pursue the aim above, the members of WG2-TG2 decided to first carry out literature data, in order to identify the best golden standard for fluorescence binding constant of a tested molecule. The idea is that we need a very material which may be easily purchased in high purity and which is stable aqueous reactions should be avoided). Toxicity should be the lowest possible never be totally harmless). Among the variety of possible binding modes, interaction is both a process of high biomedical interest and that, from the experimental one which produces the higher signal changes. As for the literature review collection only on natural DNA, and not on expensive and too peculiar engineered thymus DNA was selected.

Interaction with DNA – Data treatment aspects

AUTHORS: Members of WORKING GROUP 2 (WG2 - Studies on strong and/or multifunctional ligands, macromolecules, polyelectrolytes) TASK GROUP 2 (TG2 – DNA BINDING)*

1 – INTRODUCTION

Our work on datasets production and analysis (to get K, binding constant, and n, DNA site size in base pairs) followed the following steps (where EB = Ethidium bromide and CT-DNA = CALF THYMUS DNA).

- Inter-laboratory exercise where data already present in some of the research labs on EB/CT-DNA titrations are shared and analysed in search for binding parameters.
- Inter-laboratory exercise where some research labs carried out EB/CT-DNA titrations using the same conditions (BUFFER = 0.1 M KCl, 0.01M HEPES, pH 7.4, 25.0 °C), which are shared and analysed in search of binding parameters.
- Inter-laboratory exercise where some research labs carried out EB/CT-DNA titrations using **NOT ONLY** the same conditions (BUFFER = 0.1 M KCl, 0.01M HEPES, pH 7.4, 25.0 °C) but the **SAME PROTOCOL** (see the Document "Interaction with DNA - GUIDELINES"); these titrations are shared and analysed in search for binding parameters.

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WG2

Main outcomes:

Development and testing of recommended procedures for the accurate determination of stability constants for some selected systems:

- Guidelines for proper data collection and analysis in isothermal titration calorimetry experiments



COST Action 18202 – NECTAR

Working Group 2, Task Group 5

Recommended procedure for proper data collection and analysis in isothermal titration calorimetry experiments: the case of multiple host-guest equilibria

April 2024



<https://www.cost-nectar.eu/pages/guides.html>

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WG3

Main outcomes:

Development of methodologies for thermodynamic studies of non-aqueous solutions:

- Online release of a database of chemical and physical properties of non aqueous solvents.

Below is a list of some of the most commonly used solvents. Clicking on each of them will take you to a list with the following properties: melting point, boiling point, dielectric constant, dynamic viscosity, dipole moment, donor number, acceptor number, empirical solvent polarity parameter (E_T), and normalized E_T^N .

If not denoted differently, data are taken from the book J. M. G. Barthel, H. Krienke, W. Kunz, Physical Chemistry of Electrolyte Solutions, Modern Aspects, Springer, 1998.

List of Solvents

Find the solvent...

- Acetone
- Acetonitrile
- Benzene
- 1-Butanol
- γ -Butyrolactone
- Carbon tetrachloride
- Chloroform
- Cyclohexane
- Diethylene glycol
- Diethyl carbonate
- Dimethyl sulfoxide
- 1,4-Dioxane
- Ethanol
- Ethyl acetate

Acetone

Melting point (1 atm) = **-94.7 °C**
Boiling point (1 atm) = **56.29 °C**
Dielectric constant (25 °C) = **20.56**
Dynamic viscosity (25 °C) = **0.303 mPa·s**
Density (25 °C) = **0.7844 kg·dm⁻³**
Dipole moment (in the gas phase) = **2.69 D**
Donor number (+info) = **17.0 kcal·mol⁻¹**
Acceptor number (+info) = **12.5**
 E_T (30) (+info) = **42.2 kcal·mol⁻¹**
 E_T^N (+info) = **0.35**

(Click to clear)

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WG3

Main outcomes:

Development of methodologies for thermodynamic studies of non-aqueous solutions:

- Online release of guidelines on the synthesis of ionic liquids.



SYNTHESIS AND PURIFICATION OF IONIC LIQUIDS

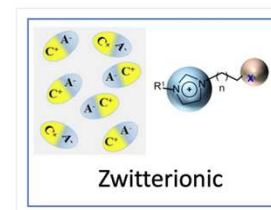
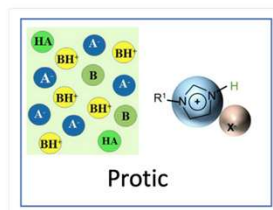
This guide outlines methods for synthesizing and purification of protic, aprotic and zwitterionic ionic liquids, including alternative and cleaner approaches. The synthesis of ionic liquids involves several steps, including identification of the reagents, choosing the appropriate solvent and optimizing the reaction conditions. The guideline for synthesizing these liquids requires understanding the basic principles of ionic liquid synthesis, selecting the right reactants based on the desired properties and conducting the reaction under proper conditions. The steps involved include selecting the cation and anion, selecting the solvent, reaction optimization and purification. Each of these steps is critical to ensure the successful synthesis of high-quality ionic liquids that meet the desired specifications.

Synthesis of Ionic Liquids

Purification and Challenges

SYNTHESIS AND PURIFICATION OF IONIC LIQUIDS

Synthesis of Ionic Liquids



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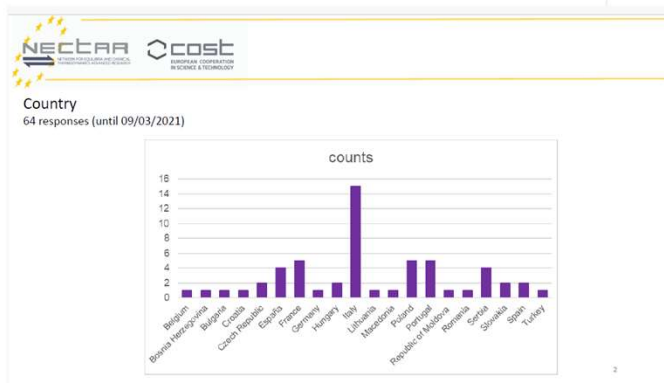
WG4

Main outcomes:

Dedicated surveys comparisons and release of new software:

WG4 activity - NECTAR survey 1

SOFTWARE COMMONLY USED BY NECTAR COMMUNITY



WG4 activity - NECTAR survey 2

KEY PARAMETERS FOR POTENTIOMETRIC AND SPECTROPHOTOMETRIC EXPERIMENTS

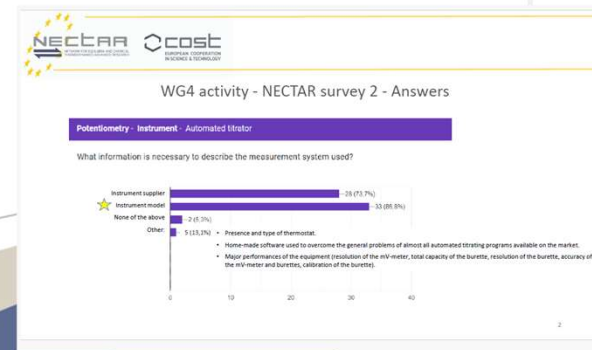
Instruments, experimental conditions and data treatment procedures are key factors to define reliable equilibrium constant values. It is necessary to know many of these parameters in order to replicate the experiment.

Assuming you need/want to share raw data with the scientific community,
which parameters do you consider necessary to completely define the experiment?

★ Parameters with more than 80% responses



<https://www.cost-nectar.eu/pages/guides.html>



Main outcomes:

Release/publication of a critical comparison between available software for potentiometric data analysis.



Analytica Chimica Acta

Volume 1303, 15 May 2024, 342476



A tutorial on potentiometric data processing. Analysis of software for optimization of protonation constants

Silvia Berto^a, Salvador Blasco^b, Lorenzo Castellino^a, Aleksandar Cvetkovski^c, Concetta De Stefano^d, Sofia Gama^e, Enrique García-España^b, Petr Hermann^f, Gabriele Lando^d, Matteo Marafante^a, Michel Meyer^g, Winfried Plass^h, Lauryn Quinodoz^g, Demetrio Milea^d

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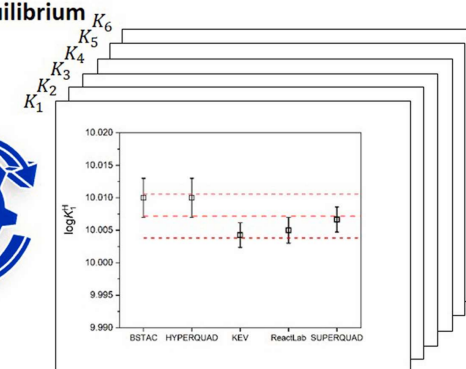
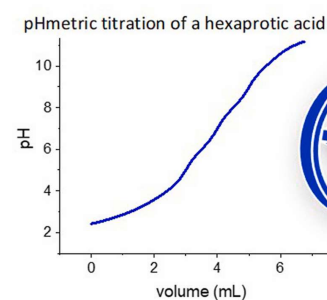
<https://doi.org/10.1016/j.aca.2024.342476>

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Analysis of tools for optimization of equilibrium constants from potentiometric data



<https://doi.org/10.1016/j.aca.2024.342476>

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WG4

Main outcomes:

Dedicated surveys comparisons and release of new software:

PyES, an open-source software for the computation of in solution and precipitation equilibria

PyES
Python Equilibrium Species

Software for the computation of solution and precipitation equilibria

Components: Species, Precipitates, Stability Constants, Ionic Strength, Uncertainties, Titration parameters

Species concentration, Solid species distribution, Adjusted ionic strength, Adjusted formation constants, Concentration uncertainties

The need of the (scientific) community:
an open-source, practical, modern and multi-platform application for the computation of the concentration of species in solution at equilibrium.

Free to download: <https://github.com/Kastakin/PyES>

Logos: NECTAR, COST, and a group of scientists.

GEMS - The GEneral Microspeciation Solver

A program aimed at solving acid-base microspeciation equilibria from NMR and spectroscopic data.

SpectrApp, a one-stop solution for small to mid-sized soft modeling problems.

It provides tools for loading, cleaning and manipulating datasets coming from different sources



<https://www.cost-nectar.eu/pages/software.html>

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WG4

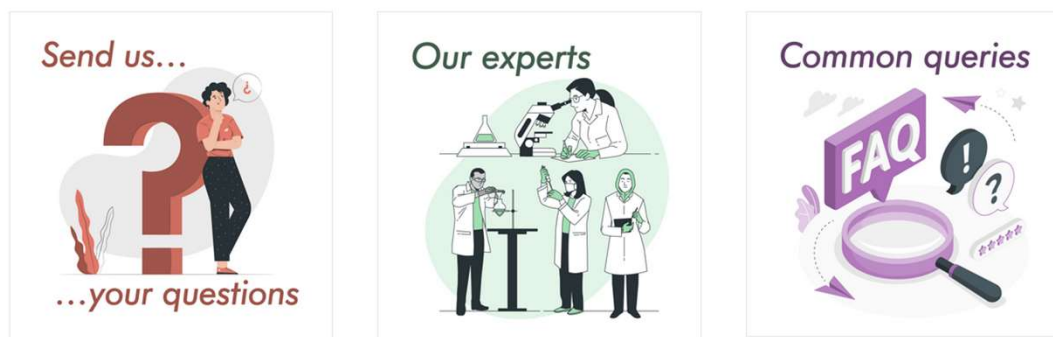
Main outcomes:

NECTAR Q/A solution environment for enterprises and other stakeholders: “Connect with an Expert”



CONNECT WITH AN EXPERT

Use our contact form to reach the right expert at NECTAR COST Action and get the support that you need.



<https://www.cost-nectar.eu/pages/expert.html>

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WG5

Communication and dissemination:

- www.cost-nectar.eu



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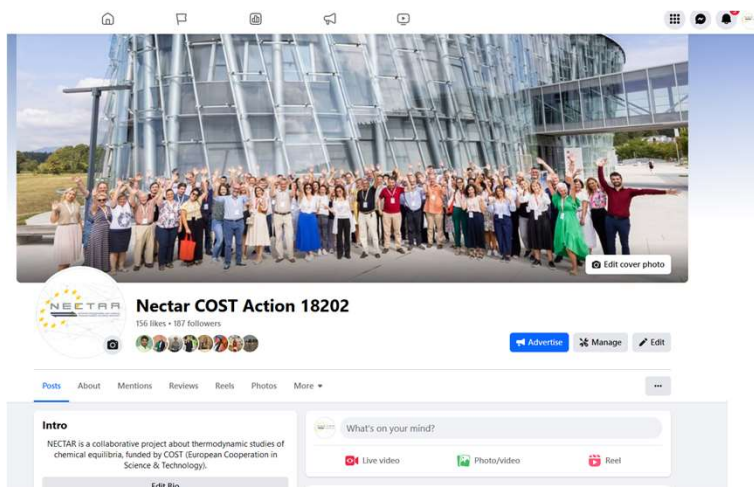
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WG5

Communication and dissemination:

- www.cost-nectar.eu



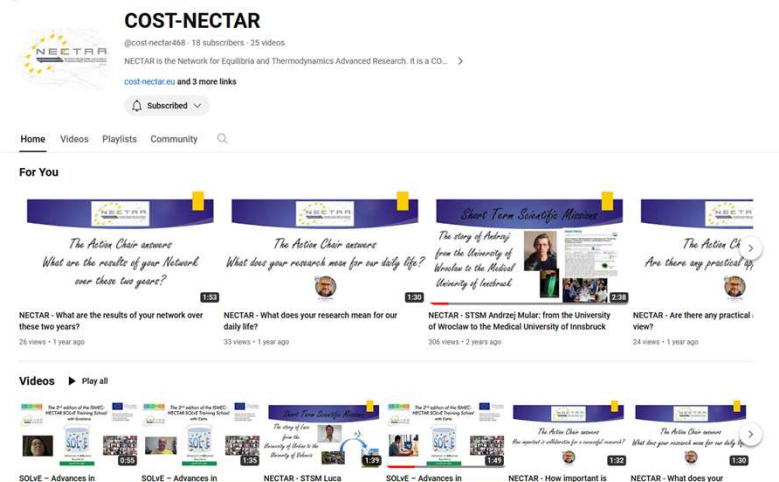
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<https://x.com/CostNectar>

<https://www.youtube.com/@cost-nectar468/featured>

<https://www.linkedin.com/in/nectar-cost-action-024aa6210/>



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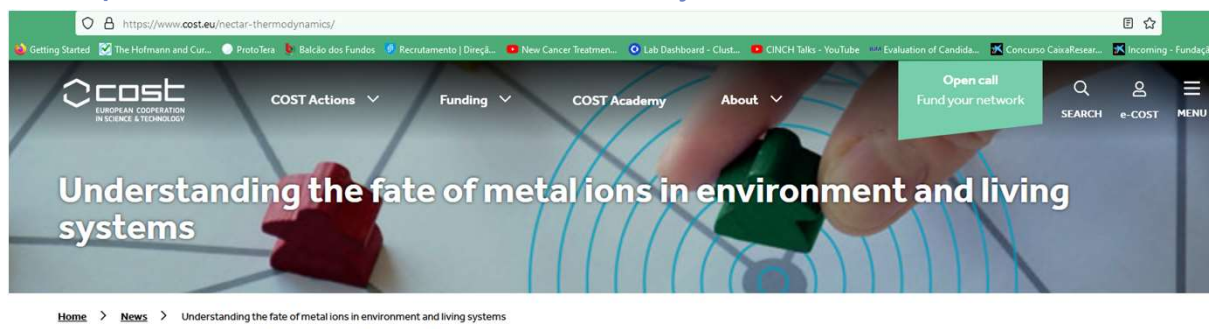
WG5

Communication and dissemination:



- www.cost-nectar.eu

- <https://www.cost.eu/nectar-thermodynamics/>



03/10/2022

NECTAR COST Action investigates potential solutions

The thermodynamic study of chemical equilibria embraces all areas of chemical sciences. Chemical compounds are present in different environments. The fundamental knowledge of the thermodynamics of chemical processes has a tremendous impact on many disciplines such as biology, medicine, environmental sciences, agriculture, and engineering.

Speciation modelling based on chemical equilibrium data allows us to identify these forms and is commonly used as a predictive tool for the behaviour of compounds in different environments. This improves commercial products' performance, discloses the mobility of pollutants and toxicants in the environment, optimises industrial processes, and explains the mode of action of biologically active substances. Furthermore, advanced thermodynamic studies yield deeper insights into the mechanisms of these interactions.



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Communication and dissemination:

83 papers from collaborations among NECTAR members, some as OA.



PUBLICATIONS

2024

[1] "Molecularly imprinted polypyrrole-based electrochemical melamine sensors."

E. Brazysa, V. Ratautaite, B. Brašiunas, A. Ramanavičienė, L. Rodríguez, A. Pinto, D. Milea, U. Prentice & A. Ramanavičius; *Microchemical Journal* (2024), **199**, 109890. DOI: 10.1016/j.microc.2024.109890

[2] "Favipiravir vs. Deferiprone: Tautomeric, photophysical, *in vitro* biological studies, and binding interactions with SARS-Cov-2-M^{Pro}/ACE2."

N. T. Tzvetkov, M. I. Peeva, M. G. Georgieva, V. Deneva, A. A. Balacheva, I. P. Bogdanov, M. Ponticelli, L. Milella, K. Kirilov, M. Matin, H.-G. Stammer, A. G. Atanasov & L. Antonov; *Current Research in Biotechnology* (2024), **7**, 100176. DOI: 10.1016/j.crbiot.2024.100176

[3] "Solution chemistry of oxidovanadium(IV) complexes with two bis-kojic acid derivatives."

R. Cappai, A. Fantasia, G. Sciortino, D. Sanna, F. Pisanu, E. Garribba, M. A. Santos, G. Crisponi & V. M. Nurchi; *Journal of Molecular Liquids* (2024), **396**, 124027. DOI: 10.1016/j.molliq.2024.124027

[4] "Is methyl salicylate the perfect organic solvent for caffeine?"

M. Vraneš, T. Teodora Borović, J. Panić, M. Bešter-Rogač, N. Janković & S. Papović; *Sustainable Chemistry and Pharmacy* (2024), **37**, 101361. DOI: 10.1016/j.scp.2023.101361

[5] "Organometallic Ru(II), Rh(III) and Re(I) complexes of sterane-based bidentate ligands: synthesis, solution speciation, interaction with biomolecules and anticancer activity."

T. Pivarcsik, M. A. Kiss, U. Rapuš, J. Kljun, G. Spengler, É. Frank, I. Turel & É. A. Enyedy; *Dalton Transactions* (2024), **53**, 4984-5000. DOI: 10.1039/D3DT04138G

[6] "Impact of metal coordination and pH on the antimicrobial activity of histatin 5 and the products of its hydrolysis."

E. Dzień, J. Wątył, A. Kola, A. Mikołajczyk, A. Miller, A. Matera-Witkiewicz, D. Valensin & M. Rowińska-Zyrek; *Dalton transactions* (2024), *Advanced article*. DOI: 10.1039/D4DT00565A

[7] "A tutorial on potentiometric data processing. Analysis of software for optimization of protonation constants."

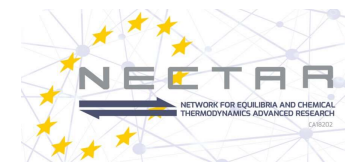
S. Berto, S. Blasco, L. Castellino, A. Cvetkovski, C. De Stefano, S. Gama, E. García-España, P. Hermann, G. Lando, M. Marafante, M. Meyer, W. Plass, L. Quinodoz & D. Milea; *Analytica Chimica Acta* (2024), **1303**, 342476. DOI: 10.1016/j.jaca.2024.342476



<https://www.cost-nectar.eu/pages/publications.html>

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Grants:

- 66 STSMs and 2 ITCGs

Influence of chaotropic and kosmotropic additives on thermodynamic parameters of caffeine self-aggregation in water

Origin Institution: Novi Sad (Serbia) PMF, Faculty of Sciences, University of Novi Sad
Host Institution: Ljubljana (Slovenia) FKKT, Faculty of Chemistry and Chemical Technology, University of Ljubljana
Prof. dr. Marija Bešter-Rogač

Teona Teodora Borović

The purpose of the STSM was to investigate how additives increase the solubility of caffeine in water, the mechanisms of interaction between caffeine and appropriate additives to prevent the self-aggregation of caffeine molecules in water, theoretical examination of caffeine of selected additives, with computer simulations using advanced software packages. The STSM was very important, and I was educated to use different instruments independently. It also helped me learn more about molecular dynamic simulations, which will be crucial for my career.

Learning new skills
Making new friendships
Sharing different experiences

Ljubljana is a city of rich culture and beautiful nature, where all these beauties combine with science.

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Determination of Protonation Constants via NMR Spectroscopy

Padova, Italy
Lisboa, Portugal

Instrumentation
Laboratory setup
Experiment setup
Good laboratory practice

Specific software
Specification model
Equilibrium constants

Experiments
Data Analysis

NMR Spectroscopy
Hyperquad
HypNMR

pH Potentiometry
Hyperquad

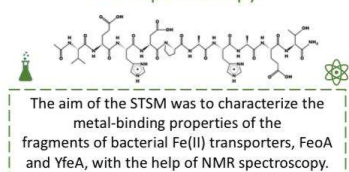
Short-Term Scientific Mission (STSM) – Lisbon, April 2023
Sara Francis, University of Padova, Italy @Sara_Francis

MSc Bartosz Orzel

University of Wrocław, Poland
Uniwersytet Wrocławski

“Thermodynamic Minds”

Exploring the metal coordination chemistry of Fe(II) bacterial transporters with the use of NMR spectroscopy.



Prof. Massimiliano Francesco Peana

University of Sassari, Italy
Università degli Studi di Sassari



CA18202 STSM

Molecular interaction study of platinum(II) anticancer drugs with human serum albumin using molecular docking methods.

13/03/2023-27/03/2023

Origin Institution: University of Udine, Udine, Italy. Department of Engineering and Architecture.
PhD candidate: **Maria Cracchiolo**

Host Institution: CENTRO UNIVERSITARIO DE LA DEFENSA SAN JAVIER. Centro Universitario de la Defensa, Academia General del Aire, Universidad Politécnica de Cartagena, Santiago de la Ribera, Spain.

The purpose of the STSM was to study the interaction between platinum(II) anticancer drugs with human serum albumin using molecular docking methods to obtain a better definition of the HSA-platinum(II) complexes.

<https://www.cost-nectar.eu/pages/stsm.html>

<https://www.cost-nectar.eu/pages/itc.html>

An amazing opportunity to gain new skills, learn about Sardinian culture and establish international cooperation!

Study of the interaction of potential anticancer platinum(II) complexes with DNA

1638 km to see the leaning tower

NICOLAOS CORNIGIUS UNIVERSITY IN TORONTO Faculty of Chemistry
UNIVERSITÀ DI PISA

and study the interactions of compounds of interest with biomolecules.

UNIVERSITÀ DI PISA

Funded by the European Union

DNA INTERACTION

Intercalation
Covalent binding
Viscosity

BSA INTERACTION

25 °C
37 °C

Weak interaction with BSA

Fluorescent titrations

No significant changes observed. The mechanism of cytotoxicity of the tested platinum(II) complex does not result from DNA binding.

$K=2,49 \times 10^3$

$K=7,17 \times 10^4$

• The research carried out during the internship at the University of Pisa showed that the tested platinum(II) compound does not interact with DNA. Despite this, this compound shows high cytotoxicity against cancer cells, so the mechanism of its interaction should be sought in reaction with other biomolecules.
• These studies also showed that this compound has a weak interaction with albumin, suggesting that it will not be transported by this biomolecule in the patient's body.

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Network for Equilibria and Chemical Thermodynamics Advanced Research COST ACTION 18202



Meetings:

<https://www.cost-nectar.eu/pages/meetings.html>



- 1st European NECTAR Conference, Belgrade, 5-6/Mar/2020
- NECTAR Spring Web-Meeting, 25-26/Mar/2021
- 2nd European NECTAR Conference, Lisbon, 25-27/Aug/2021
- WG1 NECTAR Workshop, Orsay, 31Mar-01Apr/2022
- WG2 and WG4 joint NECTAR Workshop, Valência, 9-10/Jun/2022
- 3rd European NECTAR Conference, Ljubljana, 24-26/Aug/2022
- WG5 NECTAR Workshop, Cagliari, 30/May/2023
- WG2 and WG4 joint NECTAR Workshop, Urbino, 14-15/Jun/2023
- NECTAR WG3 Workshop, Chişinău, 29-30/Aug/2023
- 4th European NECTAR Conference and Final Action Meeting, Milazzo, 26-27/Feb/2024
- Regular (monthly) virtual MC/CG/WG meetings



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Training Schools:

https://www.cost-nectar.eu/pages/1st_ts.html

“Thermodynamic Minds”

- 3 SOLvE - ISMEC-NECTAR TS on the Determination, Analysis and Use of Thermodynamic Data (1st: 26–28/Jul/2021, 2nd: 25–27/Jul/2022, 3rd: 24-26/Jul/2023).

Experimental details on data generation Potentiometry

Nuclear Magnetic Resonance (NMR) Fast recovery and magnetization transfer to the equilibrium

1st ISMEC-NECTAR Training School on the Determination, Analysis and Use of Thermodynamic Data

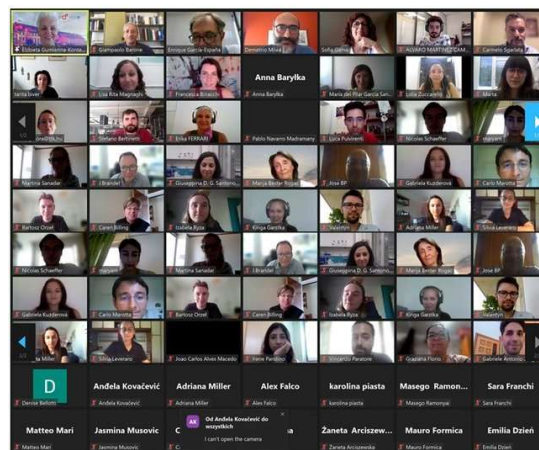
Spectrophotometric and spectrofluorometric measurements for solution equilibria

Advances in SOLUTION Equilibria

Isotermal titration calorimetry (ITC) A powerful technique for the simultaneous determination of real ΔH values of chemical equilibria

TO BE CONTINUED...

 2nd ISMEC-NECTAR Training School on the Determination, Analysis and Use of Thermodynamic Data
Advances in SOLUTION Equilibria
25-27 July, 2022




International Group for the Thermodynamics of Complexes


NETWORK FOR EQUILIBRIA AND CHEMICAL THERMODYNAMICS ADVANCED RESEARCH CA18202

3rd ISMEC-NECTAR Training School on the Determination, Analysis and Use of Thermodynamic Data



Advances in SOLUTION Equilibria



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Training Schools:

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- 3 SOLvE - ISMEC-NECTAR TS on the Determination, Analysis and Use of Thermodynamic Data (1st: 26–28/Jul/2021, 2nd: 25–27/Jul/2022, 3rd: 24-26/Jul/2023).
- NECTAR TS on Calorimetry, Ljubljana, 27/Aug/2022.



- NECTAR Advanced school on aqua ions and hydrolysis-related equilibria, Zagreb, 29/Sep/2023.

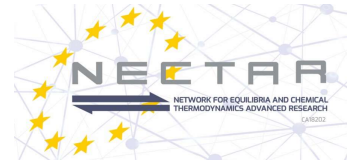
“Thermodynamic Minds”



- NECTAR TS on Communication in Science (NECTAR-SciComm), Cagliari, 29/May/2023.

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COST ACTION 18202



Sustaining the network beyond the Action

There are many ongoing projects and collaborations ongoing.

A CIG (*SOFTSTAC – SOFTware for STability Constants determination*) has also been submitted.

The training of ECIs and the new "thermodynamic minds" will ensure a high standard for future research in the field of chemical thermodynamics.

Dissemination and communication activities are already promoting public awareness of the importance of this field in daily life, ensuring a high interest for NECTAR activities even beyond the Action end.