

# COST

Domain Committee "*Chemistry and Molecular Sciences and Technologies (CMST)*"

## **COST Action CM1101**

**Start Date** 19.01.2012

*Colloidal Aspects of Nanoscience for Innovative Processes and Materials*

## **MONITORING PROGRESS REPORT**

**Reporting Period:** from 19.01.2012  
to 28.02.2013

This Report is presented to the relevant Domain Committee.  
It contains three parts:

- I. Management Report** prepared by the Grant Holder
- II. Scientific Report** prepared by the Chair of the Management Committee of the Action
- III. Previous versions of the Scientific Report;** i.e., part II of past reporting periods

The report is a "cumulative" report, i.e. it is updated annually and covers the entire period of the Action.

Confidentiality: the documents will be made available to the public via the COST Action web page except for chapter *II.D. Self evaluation*.

Based on the monitoring results, the COST Office will decide on the following year's budget allocation.

### **Executive summary (max.250 words):**

The aim of the CM1101 Action is to provide a platform for cooperation and coordination in the European colloid-science domain directed towards development of innovative materials and processes. We use the COST instruments to achieve the synergistic effect from bringing together teams of various expertise: analytical methods and synthetic approaches; fundamental science and industrial applications; theoretical reasoning, computer modelling and state-of-the-art experimental techniques, as well as stimulating new ideas and cultivating future collaboration through interactions between scientific schools in colloid science with different styles and traditions. In the first year of the Action activity we organized five working group meetings, two training schools and the first annual conference. Out of 12 STSM, 10 were fulfilled by the Early Stage Researchers. Exchange of ideas during the meetings and STSMs resulted in the initiation of new research topics and application for the collaborative projects, which have produced and will result in high level publications.

## ***I. Management Report prepared by the Grant Holder***

### ***I.A. COST Action Fact Sheet***

- **COST Action** CM1101 - *Colloidal Aspects of Nanoscience for Innovative Processes and Materials*
- **Domain** *Chemistry and Molecular Sciences and Technologies (CMST)*

- **Action details:**

**CSO Approval:** 17.05.2011

**End date:** 18.01.2016

**Entry into force:** 19.01.2012

**Extension:** (day/month/year)

- **Objectives** (from DB as in About COST)

The general objective of the Action is to provide a platform for cooperation and coordination in the European colloid-science domain directed towards development of innovative materials and processes. The scientific aims of the action are defined by the scope of the research activities and the research objectives of the six Working Groups (WGs) of the Action:

1. Development of new theoretical approaches and novel analytical methods for monitoring and characterization of transfer of amphiphilic molecules at interfaces with application to complex processes of aggregates assembly/disassembly, delivery and removal of specified molecules for the purpose of chemical functionalization of nano- or microparticles or formation of nanostructured surface layers.
2. Formulation of new theoretical and analytical approaches to the modelling of phenomena at the frontier of quantum, nano- and micro-scales in order to establish new routes of creation of novel two- and three-dimensional assemblies, supra-particles, and hierarchical structures, with an emphasis on revealing the driving forces and main factors.
3. Development of novel, reproducible, economic and up-scalable methods of obtaining various colloidal materials, such as nano-, core-shell and microgel particles (inorganic and organic), hybrid, bio-colloidal and biomimetic materials as well as solid surfaces with well-defined roughness and functionalities.
4. Identification of new routes to designing and characterizing non-equilibrium interfacial processes, including mass, charge and heat transport phenomena in colloids and at surfaces with applications for formation of self-assembly of aggregates, mono- and multilayers, and hierarchical structures with application in electrocatalysis; photocatalysis, enzymatic reactions and bioelectrochemistry.
5. Application of the acquired knowledge for solving problems in relation to the development of better colloid-based products such as shampoos, hair and skin conditioners, food products as well as carriers of drugs and vaccines with optimized release properties.
6. Engineering of chemical processes and analytical techniques for the design of colloid-based devices at micro and nano-level, as sensors and assays with applications in medicine, electronics or energy harvesting.

The [Action](#)'s main deliverables are the increased networking in colloid chemistry through the organization of scientific events (conferences, workshops), training schools and STSMs. Through an extensive mobility program targeted to early stage researchers, it will encourage their involvement in the research at the international level.

• **Parties:** *list of countries and date of acceptance*

|                  |            |             |            |                |            |
|------------------|------------|-------------|------------|----------------|------------|
| Austria          | 15/06/2011 | Greece      | 02/08/2011 | Poland         | 22/06/2011 |
| Belgium          | 30/08/2011 | Hungary     | 17/06/2011 | Portugal       | 04/11/2011 |
| Bulgaria         | 06/06/2011 | Iceland     | -          | Romania        | 16/06/2011 |
| Croatia          | 05/09/2011 | Ireland     | 11/08/2011 | Serbia         | 08/06/2011 |
| Cyprus           | 24/01/2012 | Israel      | 06/06/2011 | Slovakia       | 15/07/2011 |
| Czech Rep.       | 23/06/2011 | Italy       | 15/06/2011 | Slovenia       | 08/06/2011 |
| Denmark          | 09/11/2011 | Latvia      | 20/06/2011 | Spain          | 28/06/2011 |
| Estonia          | -          | Lithuania   | 30/11/2011 | Sweden         | 16/09/2011 |
| Finland          | 30/08/2011 | Luxembourg  | -          | Switzerland    | 05/07/2011 |
| FYR of Macedonia | -          | Malta       | 18/10/2011 | Turkey         | 11/08/2011 |
| France           | 12/08/2011 | Netherlands | 05/09/2011 | United Kingdom | 18/07/2011 |
| Germany          | 27/06/2011 | Norway      | 30/09/2011 |                |            |

• **Intentions to accept:** *list of countries and date None*

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### **Workgroup 3: Synthesis of nano- and bio-colloidal materials: development and upscaling**

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**Workgroup 4: Kinetic and catalytic aspects of nano-colloids and nano-structured surfaces**

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**Workgroup 5: Processes and materials for everyday life and biomedical applications**

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### Workgroup 6: Colloid-based devices: sensors, assays, photonics and micro-fluidics

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**Schools**

| Title                                                                                | Date          | Place      |  |  |  |  |  |  | Cost      | Total     |
|--------------------------------------------------------------------------------------|---------------|------------|--|--|--|--|--|--|-----------|-----------|
| School on Surface Analytical Techniques                                              | 10-13.04 2012 | Regensburg |  |  |  |  |  |  | 23 967,15 |           |
| 11th European Summer School on "Scattering Methods Applied to Soft Condensed Matter" | 07-14.06 2012 | Gironde    |  |  |  |  |  |  | 7 760,00  |           |
|                                                                                      |               |            |  |  |  |  |  |  |           | 31 727,15 |

**Dissemination**

| Title           | Date       | Place             |  |  |  |  |  |  | Cost     | Total    |
|-----------------|------------|-------------------|--|--|--|--|--|--|----------|----------|
| Action Web Page | 27.02.2013 | La Valetta, Malta |  |  |  |  |  |  | 1 000,00 | 1 000,00 |

**Others**

|                 |  |  |  |  |  |  |  |  |        |        |
|-----------------|--|--|--|--|--|--|--|--|--------|--------|
| Banking charges |  |  |  |  |  |  |  |  | 566,88 | 566,88 |
|-----------------|--|--|--|--|--|--|--|--|--------|--------|

**Action Total : 175 577,93**

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**II. Scientific Report** prepared by the Chair of the Management Committee of the Action, describing results achieved during the Action operation in this period, in no more than 3 pages (the report is "cumulative"). All items listed in Sections A, B, and C, below, must be addressed.

Additional documentation such as extended scientific reports, proceedings of workshops, seminars or conferences may be provided separately as an annex to this report, and should be referenced in the report.

### **II.A. Innovative networking**

- *Innovative knowledge resulting from COST networking through the Action. (Specific examples of Results vs. Objectives)*

Examples of the project realized in the frame of WGs which resulted in generation of the new knowledge.

WG1:

- *Coadsorption of surfactants from aqueous phase and alkane from vapor;*
- *Studies of the effect of surface active substances on the bubble bouncing and velocity of the three phase contact formation;*
- *New method of detection of products of enzymatic hydrolysis of phospholipids at interfaces;*
- *Studies on the interfacial layers of hydrophobin; Effect of hydrophobins on foam coarsening and surface rheology;*
- *Theoretical model of disjoining pressure in the presence of rod-like polyions;*
- *Properties and Structure of Palmitic Acid – Silica nanoparticles interfacial layers at liquid interfaces;*
- *Interfacial characteristics of aqueous solutions of grafted copolymers and indomethacin;*
- *Particle laden fluid interfaces;*
- *Freezing of nanofluid droplets;*
- *Confocal and ESEM studies of emulsions obtained by phase inversion.*
- *Computer simulations and experimental studies of evaporation of surfactant solution droplets;*

WG2:

- *New method is developed for the determination of the aggregation number and charge of ionic surfactant micelles by analysis of the step-wise thinning of foam films formed from micellar surfactant solutions.*
- *Parallel and sequential adsorption of two different proteins, BSA and b-casein, at the air-water interface.*
- *Origin of ion-specificity in ion selective electrodes.*
- *Ion-specific hydration effects: Extending the Poisson-Boltzmann theory.*
- *Control of foam film and wetting film stability by addition of electrolytes: Electrostatics vs. ion specificity*
- *Oscillatory forces: Determining the charge and aggregation number of ionic surfactant micelles from the stepwise thinning of foam films;*
- *Poisson-Boltzmann based theory of protein adsorption – particles with nonuniform charge distribution*
- *Interdependence of perpendicular and lateral equations of state of phospholipid bilayers mediated by salts*

WG3:

- *Hot injection method for the preparation of colloidal solutions of hydrophobic gold nanoparticles with diameter around 20 nm and size dispersion below 20%.*
- *Nanoparticles with tunable architecture*
- *Cellulose-based gel for biomedical application*
- *Tuning the nano-assembly of oppositely charged polyelectrolytes with non ionic surfactants*
- *Phase behavior in hyaluronan-CTAB aqueous systems*
- *New devices to detect traces of explosives in contaminated soils or/and complex samples*
- *Chemical structure of the polyfunctional pyridinium amphiphiles on base of 1,4-*

*dihydropyridine (1,4-DHP) core - physico-chemical and biological activities*

- *Microgel with double transition*
- *Au@PNIPAM 2D ensembles on a metallic surface*
- *Protein-DNA-gel particles and core-shell structures*
- *Reconstitution of membrane proteins on surfaces*

WG4:

- *Water shifts catalytic reactions*
- *Resolution of Microscopic Protonation Enthalpies of Polyprotic Molecules by Means of Cluster Expansions*
- *Surface properties of biosurfactant saponin and its interaction with biomolecules*
- *Interaction of saponins with biomolecules*
- *Hofmeister effect at the water/air interface*

WG5:

- *Hydration force in a multi-scale polymer dispersion: modelling of wood fibres swelling/deswelling by atmospheric humidity*
- *Biocompatible microemulsions for transdermal administration of drugs*
- *Antimicrobial properties of novel nanostructured with silver-tiopronin nanoparticles bone cement*
- *Preparation of anthracycline-loaded colloidal nanoparticles for cancer chemotherapy*
- *Encapsulation of anticancer drugs and for treatment of neurodegenerative diseases*
- *Surface plasmon resonance – tool for study of interaction of colloidal drug carriers with proteins*

WG6:

- *New electrical technique for detecting bubbles in living objects;*
- *Synthesis of conducting polymers*
- *Sinterable Ag nanoparticles for printed electronics application*
- *Development of nano-additive inkjet inks for textile functionalization;*
- *New multi-exchange pendant drop tensiometer for in-vitro digestion studies;*

- *Significant scientific breakthroughs as part of the COST Action. (Specific examples)*

*New scientific results of some significance:*

- *Results on water in paraffin oil emulsions stabilized by SPAN 80 have been obtained at the University of Marseille. Which showed the occurring of self emulsification mechanisms. Temperature controlled experiments revealed that the kinetics of this transport mechanism depends mainly on the SPAN80 concentration and not on the aqueous phase. The composition of this latter has been modified with CTAB and silicon oxide nano-particles and no significant effect observed in the overall transport kinetics. Cryo-SEM measurements revealed the formation of vesicles at the water-paraffin oil interface. X-ray and IR spectroscopy confirmed that droplets consist in water.*
- *Carbon based particulate associated with appropriate surfactants has been utilised, at CNR-IENI, to stabilise foams used as precursors for the production of carbon based porous materials with specific features depending on the interfacial properties of the initial surfactant –particle suspension.*
- *Novel analytical methods have been developed, at the University of Naples, for the interfacial characterization in colloidal systems. A new techniques, based on confocal microscopy, was used to image the microstructure of multilamellar surfactant droplets and provide an interpretation of their deformability under an applied shear flow.*
- *Accumulation of bromide ions in the Stern part of the electrical double layer (EDL) near a Gibbs monolayer of cationic surfactant, cetyltrimethylammonium bromide (CTABr), at the water-air interface was probed by the total reflection X-ray fluorescence (TRXF). A combination of TRXF with surface tension data allowed for the first time to determine the adsorbed amounts of bromide ions in the Stern and diffuse parts of EDL. TRXF and X-ray reflectivity (XR) were employed to probe the competitive adsorption of other anions present in the aqueous solution. The Gibbs monolayers of CTABr were studied*

in the absence and presence of different anions from the Hofmeister series ( $\text{Br}^-$ ,  $\text{NO}_3^-$ ,  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{H}_2\text{PO}_4^-$ ,  $\text{ClO}_4^-$ ,  $\text{I}^-$ ) with the aim to compare their affinity to the interface positively charged by adsorption of surface-active  $\text{CTA}^+$  cation. For studying the effect of anions on adsorption of CTABr, the concentration of the latter was kept constant ( $10^{-4}$  M), and that of  $\text{NaX}$  ( $\text{X}^- = \text{Br}^-$ ,  $\text{NO}_3^-$ ,  $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{H}_2\text{PO}_4^-$ ,  $\text{ClO}_4^-$ ,  $\text{I}^-$ ) was varied between  $10^{-2}$  M and  $10^{-5}$  M. The results clearly show the competition between anions for the positively charged aqueous-air interface, with  $\text{F}^-$  being the least “surface active” and  $\text{ClO}_4^-$  and  $\text{I}^-$  - the most “surface active” anions, in full agreement with the Hofmeister series.

- *Tangible medium term socio-economic impacts achieved or expected. (Specific examples)*

*Project proposed by WG2 and WG5 members concerning the artificial growth of cells for bone tissues and the integration of implants and encapsulation of anticancer drugs and for treatment of neurodegenerative diseases can significantly contribute to the improvement the development of innovative therapies.*

*More than 50 new PhD students started they program in the Action teams.*

- *Spin off of new EC RTD Framework Programme proposals/projects. (List)*

*Project proposal: Molecular Switches for Pollutants Detection; Principal Applicant: UNIVERSIDAD COMPLUTENSE DE MADRID;*

*Proposal for Marie Curie Initial Training Network – “Carriers enabling chemo enzymatic reactions” (FP7-PEOPLE-2013-ITN)*

*Project proposal – “Nature-inspired nanotechnology solutions for in-situ groundwater and soil remediation”*

*Project proposal -Tunable Nanoparticle X-ray source and Anomalous Small-angle X-ray Scattering,ERC-2013-CoG*

*Project proposal - “Chemo-hyperthermal Delivery”. ERA-Net EuroNanoMed JTC-3*

*Proposal for Marie Curie Initial Training Networks (ITN) proposal FP7-607345 MAGNET “Magnetically Activated Graphitic Nanonetworks with Electronic Tuning”.*

*Project proposal – “siRNA Eluting Coronary Stents for Reducing the Risk of Restenosis”, NMP.2013.2.2-1.*

- *Spin off of new National Programme proposals/projects:*

German-Research Council (DFG): 1) Priority program SPP 1681 on magnetic/polymer materials (submitted November 2012); 2) Individual proposal on responsive hybrid gold/polymer gels for switchable drug barriers (submitted February 2013)

German Ministry for education (BMBF): Scattering at responsive interfaces (with Swedish partners) (submitted March 2013)

Czech Research Council: “Preparation of hyaluronan-micellar-aggregate colloids for nanomedical applications and characterization of their properties” – accepted, “Hyaluronan-amino acid amphiphiles – new colloids for nanobiotechnology” – submitted;

Hungarian Scientific Research Fund: “Nonequilibrium aspects of polyelectrolyte based nanoassemblies” – submitted;

Latvian Council of Science: “Studies and characterization of nanoparticles formed by self-assembling pyridinium derivatives” – submitted; “The synthesis of amphiphilic pyrrole derivatives for development of new drug transport form” – submitted.

National Science Centre (Poland) – “Functionalization of multilayer polymer films for biomedical applications” – submitted; “Polyelectrolyte multilayers with electro-catalytically active Prussian blue nanoparticles as hydrogen peroxide sensors” – submitted ; “Multilayer polymer films containing nanoparticles and graphene as a functional coatings and membranes” – submitted

National Centre for Research and Development (Poland) – “Nanoparticulate delivery systems for therapies against neurodegenerative diseases” – together with Norway – granted.

French National Research Agency: Bio-NanoHybrid” -ANR blanc international Fr-Ro- Innovative hybrid co-encapsulation systems based on mesoporous silica – lipid nanocarriers for advanced bio-cosmetic formulations” – submitted.



## **II.B. Inter-disciplinary networking**

- *Additional knowledge obtained from working with other disciplines within the COST framework. (Specific examples)*

*Knowledge related to the artificial growth of cells for bone tissues and the integration of implants as the benefit from the participation in the “Berlin School of Regenerative Therapy” (BSRT) together with the Charité.*

*Cooperation with the COST Actions: FA COST Action FA1001 “The application of innovative fundamental food-structure-property relationships to the design of foods for health, wellness and pleasure”, MPNS COST Action MP1106 “Smart and green interfaces - from single bubbles and drops to industrial, environmental and biomedical applications” resulted in the common paper.*

*The KTH group (Stockholm, Sweden) has been working with the Biotechnology Department at KTH, and the Faculty of Pharmacy in Madrid for development of nanodevices for water cleaning.*

*The KTH group (Stockholm, Sweden) performed the in situ study of ceria or zirconia crystallization versus temperature, groups from other COST Action- CM 1104.*

*The group at BUT (Czech Republic) has been asked for cooperation by cardiologists in the area of ultrasound microbubbles as drug delivery systems.*

*The Group at the UAH (Spain) combine Forensic Chemistry and Colloidal Physical Chemistry sub-disciplines to develop sensors based on colloidal materials to trap substances of forensic interest for further analytical detection and identification with the benefit of improves sensibility and selectivity*

*The Group at ICSC (Poland) initiated the project on the nanoparticulate delivery systems for the therapies for neurodegenerative diseases together with SINTEF and Oslo University Hospital (Norway and the Institute of Pharmacology (Poland) – granted.*

- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide scientific impacts. (Specific examples)*

*This Action combines the European expertise in colloid and interface science, including: theoretical modelling and experimental formation of functional and patterned interfaces; self-assembly of molecules and colloidal particles; synthesis and up-scaling of novel nano-colloidal and bio-colloidal materials; the kinetic and catalytic aspects of these novel materials; and their applications in chemical, pharmaceutical and food industries, as well as in nano-devices such as sensors, assays, photonics and bio-fuel cells. Combination of expertise in physics, chemistry and material science provides high potential to provide significant scientific impact. The example of the scientific outputs can be found in the publications being the results of the first year of the Action activity.*

- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide socio-economic impacts. (Specific examples)*

*The Action has a high potential to contribute to the Grand Challenges in energy, health and environmental protection. For example in the domain of biomedicine new patents have been filed:*

*1.- Calcium Phosphate/Calcium Silicate Cement for Biomedical Applications, Inventors: Hamdan Alkhraisat Mohammad, Lopez Cabarcos Enrique*

*Title: Pub.Nº.: WO/2012/007612*

*2. Patent on new application of hyaluronan in drug delivery (under preparation). (Group of Prof. Miloslav Pekar, BUT, Czech Republic).*

*The Action contribute to the development of professional carrier of young researchers, who will become future leaders in the the European Research Area as well as in the industry.*

## **II.C. New networking**

- *Additional new members joining the Action during its life.*

*The Action started with 30 COST countries. During the first year one country (CYPRUS) joined. Participation in all working groups increased: WG1 from 15 to 21, WG2 from 26 to 30, WG3 from 26 to 36, WG4 form 7 to 13, WG5 from 12 to 21 and WG6 from 7 to 11.*

- *Total number of individual participants involved in the Action work. (Number of participants. Give % of female and of Early Stage Researcher participants)*

*88 research groups, c.a. 420 individual participants in those research groups, 40% females and 45% ESR.*

- *Involvement of Early Stage Researchers in the Action, in particular with respect to STSMs, networking activities, and Training Schools. In addition, justification should be provided if less than 4 STSMs were carried out during the year.*

*Out of 12 STSM, 10 were fulfilled by the Early Stage Researchers. Exchange of ideas during the meetings and STSMs resulted in the initiation of new research topics and application for the collaborative projects, which have produced and will result in high level publications. Two Training Schools were organized during the first year of the CM1101 Action. The first one on "Surface Analytical Techniques" were continuation of the tradition of training schools initiated under the framework of D43 Action. The major objective was to discuss modern surface analytical tools that increased our understanding of fluid interfaces. Selected surface analytical tools were presented in tutorial review style by scientists using these techniques in their daily research. The information was then discussed and deepened in small workgroups on the basis of problem sheets. 59 students (PhD students and post-docs) from 15 different countries participated in the School. The participation of ESR was also promoted during WGs meetings. 20% of oral communications were delivered by them and their participation was reimbursed by COST.*

- *Involvement of researchers from outside of COST Countries. (Number of participants from non-COST Countries approved by the CSO. Give % of such participants from countries with reciprocal agreements. Specify their contribution)*

*During the first year three institute from the NON-COST countries were approved by the CSO. One of the comes from Australia (reciprocal agreement 33%). They will contribute in the following Action activities. Another applications are pending.*

- *Advancement and promotion of scientific knowledge through publications and other outreach activities. (Number of publications and other outreach activities that resulted from COST networking through the Action. Complete list should be given in an annex)*

*Over forty publications were submitted by the Action participants (see the list below). The Action was presented at the annual conference of NanoTP COST MP0901 – „Designing novel materials for nanodevices: From Theory to Practice" and COST-info Day in Wrocław (Poland).*

- *Activities and projects with COST network colleagues.*
- *Five of the units associated in WG1, MPI-KG Potsdam (DE), University of Twente (NL), CNR-IENI (IT), Aristotle University of Thessaloniki (GR), University of Marseilles (FR), University Complutence of Madrid (SP), are collaborating in the framework of the ESA-projects FASES (Fundamentals and Applied Studies on Emulsion Stability) and PASTA (Particle Stabilized*

- Emulsions and Foams*). Project involves experiments performed under microgravity conditions.
- A collaboration between the University of Parma and The Univ. Complutense of Madrid as started during this year aimed at understanding of the connections and the discrepancies between the results of different rheology measurements on Langmuir monolayers.
  - Groups from MPI-KG and Univ. of Marseilles have been collaborating on the theme the Pickering-Emulsions and interfacial rheology.
  - An experiment at ESRF (Grenoble), in the newly started project "Study of the interaction of nanoparticles with lipid layers", is planned for April 2013, involving the group at CNR: IENI and the Univ. of Parma.
  - Structural determination by SAXS of Microemulsions considered as Drug carriers (France/Greece)
  - In situ time resolved Raman spectroscopy and X-ray powder diffraction measurements on colloidal systems (Netherlands/France)
  - The capacity of the Action members to raise research funds.

At least twenty new projects (European, National) with the total budget c.a. 6 Meuro was applied for.

#### Annex 1 - List of publications

1. K. Bohinc, D. Kovacevic and J. Pozar, Protonation equilibrium of poly(allylammonium) cation in aqueous solution of binary 1:1 electrolytes Phys. Chem. Chem. Phys., 2013, Accepted Manuscript
2. V.B. Fainerman, S.V. Lylyk, N.M. Kovalchuk, V.I. Kovalchuk, E.V. Aksenenko, J.T. Petkov and R. Miller, Effect of water hardness on surface tension and dilational visco-elasticity of sodium dodecyl sulphate solutions, J. Colloid Interface Sci., 377 (2012) 1–6
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4. E. Guzman; L. Liggieri; E. Santini; M. Ferrari; F. Ravera. Mixed DPPC-Cholesterol Langmuir Monolayers in presence of Hydrophilic Silica Nanoparticles. Colloids & Surfaces B: Biointerfaces. 105 (2013), 284 -293.
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9. E. Guzman, E. Santini, L. Liggieri, F. Ravera, G. Loglio J. Krägel, A. Maestro, R.G. Rubio, D. Grigoriev and R. Miller, "Particle-surfactant interaction at liquid interfaces, chapter 4, pp. 77-109.

10. S.E. Anachkov, K.D. Danov, E.S. Basheva, P.A. Kralchevsky, K.P. Ananthapadmanabhan, Determination of the Aggregation Number and Charge of Ionic Surfactant Micelles from the Stepwise Thinning of Foam Films. *Adv. Colloid Interface Sci.* 183-184 (2012) 55-67.
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13. M. Laurenti, F. García Blanco, E. Lopez-Cabarcos and J. Rubio-Retama. Detection of Heavy Metal Ions Using a New Synthesized Water Soluble Conjugated Polymer Based on Thiophene and Meso-2,3-dimercaptosuccinic Acid. *Polymer International* (2012) doi:10.1002/pi.4369
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