

COMPUSI SILOXANICI CA PRECURSORI PENTRU NANOMATERIALE

ICMPP Iasi

CNCSIS

PNCDI II – Program IDEI

Proiect ID_233

Contract nr. 5/28. 09.2007

Director de proiect: Dr. Carmen Racles

Perioada de derulare: 1 oct. 2007 – 30 sept. 2010

Buget total initial: 750 000 RON

Buget total aprobat: 632 700 RON

COMPUSI SILOXANICI CA PRECURSORI PENTRU NANOMATERIALE

ECHIPA PROIECTULUI

Dr. Carmen Racleș - director de proiect

Dr. Maria Cazacu

Dr. Vasile Cozan

Dr. Aurelia Ioanid

Tineri doctoranzi:

Mihaela Alexandru

George Stiubianu

COMPUSI SILOXANICI CA PRECURSORI PENTRU NANOMATERIALE

REZUMATUL PROIECTULUI

Plecand de la cunoscuta incompatibilitate a polisiloxanilor cu majoritatea polimerilor organici, proiectul isi propune cresterea gradului de cunoastere privind posibilitatea de control a morfologiei bifazice in sistemele siloxan-organice, pentru a obtine materiale nanostructurate cu proprietati speciale si potentiale aplicatii in domenii de varf. Se vor investiga noi perspective in ce priveste relatiile structura-morfologie-proprietati in materialele multifunctionale continand siloxan. Vor fi obtinute noi sisteme organo-siloxanice (copolimeri, blenduri polimerice si sisteme polimer-disperse) si vor fi studiate pentru a observa nano-organizarea in stare solida, in solutie sau topitura si pentru a intelege influenta morfologiei bifazice asupra proprietatilor globale si de suprafata. Sinteza copolimerilor continand siloxan cu diverse arhitecturi va fi realizata prin reactii de policondensare sau poliaditie, plecand de la macromeri preformati. Structurile vor fi confirmate prin metode spectrale (RMN, FT-IR) si proprietatile lor vor fi investigate prin DSC, DMA, spectroscopie UV-VIZ, microscopie optica in lumina polarizata (POM). Morfologia bifazica si nanostructurarea vor fi evidentiate prin analize TEM, SEM, AFM, XRD si XPS. Vom investiga potentialul unor surfactanti si cristale lichide siloxanice pentru utilizare ca nanoreactoare sau nanocontainere. Se va testa prepararea unor nano-obiecte, inclusiv nanoparticule polimerice prin nanoprecipitare sau reactii de polimerizare ori policondensare in nanoreactoare constand din structuri supramoleculare bifazice siloxan-organice. Nano-materialele rezultate vor putea fi folosite fie ca faza dispersa in blenduri polimerice si sisteme polimer-disperse, fie ca vehicule pentru substante active. Se va urmari aplicarea cu precadere a materialelor biocompatibile sau biodegradabile si folosirea formularilor in faza apoasa, avand drept tinta finala aplicatii in domeniul medical si al produselor de ingrijire.

COMPUSI SILOXANICI CA PRECURSORI PENTRU NANOMATERIALE

Obiectiv general: *cresterea gradului de cunoastere in domeniul controlului morfologiei bifazice in sistemele continand siloxani, cu scopul de a obtine materiale nanostructurate.*

Obiectivele specifice:

- sinteza de noi sisteme bi/multifazice continand siloxani (copolimeri, amestecuri de polimeri, sisteme polimer-disperse) si studiul lor din punct de vedere morfologic, pentru intelegerea influentei morfologiei bifazice asupra proprietatilor globale si de suprafata;
- testarea unor abordari neconventionale pentru sinteza de nanoparticule, in special sinteza in “nanoreactoare” pe baza de compusi siloxan-organici;
- folosirea nanoparticulelor polimerice in scopuri neconventionale (de exemplu ca faza dispersa in amestecuri);
- explorarea formularilor in faza apoasa continand nanoreactoare si nanocontainere pe baza de siloxani pentru aplicatii tinta, precum sisteme de transport si eliberare de medicamente, acoperiri, vopsele, produse de ingrijire personala.

COMPUSI SILOXANICI CA PRECURSORI PENTRU NANOMATERIALE

BUGETUL PROIECTULUI (RON) DEVIZ CADRU ANTECALCUL

NR. CRT	DENUMIRE CAPITOL BUGET	TOTAL VALOARE 2007 ¹ (lei)	TOTAL VALOARE 2008 ¹ (lei)	TOTAL VALOARE 2009 ¹ (lei)	TOTAL VALOARE 2010 ² (lei)	TOTAL VALOARE (lei)
1.	CHELTUIELI DE PERSONAL	29000	120000	84211	100000	333211
2.	CHELTUIELI INDIRECTE <i>(regie)</i>	18571	71428	36875	42550	169424
3	MOBILITĂȚI	0	10000	1146	3000	14146
4.	CHELTUIELI DE LOGISTICĂ pentru derularea proiectului	17429	48572	25268	24650	115919
5.	TOTAL	65000	250000	147500	170200	632700

1- Valoare decontata

2- Buget aprobat

Obiective propuse si indeplinite in totalitate

An	Obiective	Activități
2007	1. Sinteza de compusi siloxanici multifunctionali	1.1. Alegerea partenerilor organici si sinteza precursorilor
		1.2. Reactii de obtinere a polimerilor
	2. Caracterizarea fizico-chimica a compusilor siloxan-organici	2.1. Caracterizare spectrala
		2.2. Caracterizare termica
2008	1. Studiul morfologiei unor polimeri bifazici continand unitati siloxanice	1.1. Observatii de microscopie electronica si AFM
		1.2. Corelatii structura-morfologie
	2. Sinteza de compusi siloxanici amfifili	2.1. Sinteza unor macromeri si polimeri amfifili siloxan-organici
		2.2. Caracterizarea fizico-chimica a compusilor amfifili
	3. Caracterizarea surfactantilor siloxanici	3.1. Studiul proprietatilor de suprafata
		3.2. Teste preliminare de stabilizare a nanoparticulelor
2009	1. Obtinerea de nanoparticule polimere prin metode fizice	1.1. Prepararea de nanoparticule stabilizate cu surfactanti siloxanici
	2. Sinteza unor polimeri in "nanoreactoare" siloxanice	2.1. Alegerea reactantilor si conditiilor de lucru
		2.2. Reactii chimice in prezenta de compusi siloxanici amfifili
	3. Caracterizarea dimensionala a nanoparticulelor obtinute	3.1. Masurarea dimensiunilor nanoparticulelor si distributiei acestora
		3.2. Observarea formei si dimensiunilor nanoparticulelor prin microscopie electronica

Obiective propuse

	Obiective	Activități
2010	1. Sinteza si caracterizarea unor cristale lichide siloxanice	1.1. Proiectarea structurilor si realizarea sintezelor
		1.2. Caracterizarea structurala si termotropa, cu evidentierea mezofazelor smectice
	2. Obținerea de nanocompozite pe baza de compusi siloxanici	2.1. Obținerea si investigarea unor amestecuri polimer-nanoparticule polimere
		2.2. Obținerea si investigarea unor nanocompozite siloxanice cu diverse nanoparticule ca materiale disperse
	3. Investigarea folosirii compusilor siloxanici in sisteme polimer-medicament	3.1. Obținerea de nanoparticule continand principii active
		3.2. Caracterizarea dimensionala si evaluarea stabilitatii

Rezultate obtinute

2007

- Noi precursori organici mezogeni;
- Copolimeri siloxan-organici cu grupe chelatoare;
- Copolimeri siloxanici cu grupe functionale pendante;
- Compusi multifunctionali nanoporosi.
- Caracterizarea structurala prin metode spectrale
- Caracterizarea termica /termotropa.

2008

- Observatii de microscopie electronica si AFM si corelatii structura-morfologie in cazul unor copolimeri segmentati si unor co-retele amfifile siloxan-organice ;
- Obtinerea si caracterizarea unor noi compusi amfifili siloxan-organici cu potential de surfactanti ne-ionici, avand diverse arhitecturi (macromeri liniari sau ciclici, copolimeri cu grupe functionale pendante), si unitati hidrofile derivate de monozaharide si THMAM ;
- Investigarea unor compusi siloxanici amfifili solubili in apa privind proprietatile de suprafata si capacitatea de stabilizare a nanoparticulelor (teste preliminare prin nanoprecipitare si reactii chimice).

2009

- Utilizarea auto-asocierii copolimerilor segmentati in solventi selectivi pentru obtinerea de nanoparticule de complexi metalici.
- Realizarea si studiul de reactii chimice in apa, in prezenta surfactantilor siloxanici cu structuri originale, pentru obtinerea de nanoparticule.
- Investigarea dimensiunilor si stabilitatii particulelor obtinute in diferite sisteme surfactant-polimer.

IMPLICAREA TINERILOR DOCTORANZI

MIHAELA ALEXANDRU (doctorand din anul 2006) –doctorand fara frecventa; grad de implicare (2007-2009) - 100%

Titlul tezei de doctorat: **Structuri siloxan-organice si siloxan-anorganice reticulate, obtinute prin tehnica sol-gel.**

-Utilizarea tehnicii sol-gel pentru obtinerea de materiale hibride organic-anorganice.

-In functie de modul de combinare ale componentelor organice si anorganice folosind tehnica sol-gel se pot obtine urmatoarele clase de compusi: IPN, retele amfifile, compozite si hibrizi adevarati.

-Polisiloxanii functionalizati cu grupe clormetil s-au folosit drept precursori pentru obtinerea de retele amfifile cu diamine aromatice. Desfasurarea acestei reactii intr-un sistem de silice sol-gel conduce la formarea de materiale in care segmentele organice puternic polare se separa in nanodomenii a caror forma si dimensiuni poate fi dirijata prin sinteza.

-Prin folosirea tehnicii sol-gel se pot ranfora polimeri siloxanici cu silice generata *in-situ* sau alti oxizi anorganici sub forma de retele sau nanoparticule.

Rezultate

1. M. Cazacu, A. Vlad, A. Airinei, M. Alexandru: Silica encapsulating lanthanum complexes using the sol-gel technique, *Polym. Int.* 57: 1067-1074, 2008.
2. C. Racles, M. Alexandru, M. Cazacu, A. Ioanid, T. Hamaide: Obtention des elastomeres silicones en nanoreacteurs siloxane-organiques; *Rev. Roum. Chim.* –2009, 54(7), 583–588.
3. Maria Cazacu, Carmen Racles, Anton Airinei, Mihaela Alexandru, Angelica Vlad: Association Phenomena of the Ferrocenylsiloxane Polyamide in Solution, *Journal of Polymer Science: Part A: Polymer Chemistry*, Vol. 47, 5845–5852 (2009)
4. M. Alexandru, C. Racles, M. Cazacu : Siloxane-organic hybrids. Evaluation of some surface properties by tensiometry, *Journal of Optoelectronics and Advanced Materials - Symposia*, Vol. 1, No. 6, 2009, p. 1095 - 11002.
- 5) M. Alexandru, M. Cazacu, C. Racles, C. Grigoras: Amphiphile polydimethylsiloxane-based networks reinforced with in situ generated silica trimisa *Polymer Engineering and Science*
- 6) Mihaela Alexandru, Carmen Racles, Maria Cazacu: Siloxane-organic hybrids. Evaluation of some surface properties by tensiometry *Comunicare - International Conference on Materials Science and Engineering, February 26-28, 2009, Brasov, Romania*

GEORGE STIUBIANU (doctorand din anul 2007) –doctorand fara frecventa; grad de implicare (2007-2009)- 100%
Titlul tezei de doctorat: Materiale hibride pe baza de siloxani si derivati lignocelulozici

Materialele polimerice naturale precum celuloza si lignina pot constitui baza pentru obtinerea de materiale cu proprietati mecanice superioare. Combinarea siloxanilor cu caracter hidrofob cu materiale naturale precum lanturi polimerice de celuloza, microfibrile de celuloza, nanopulbere de lignina, nanotuburi produse pornind de la celuloza, duce la obtinerea de materiale cu proprietati noi: materiale ceramice cu rezistenta mecanica ridicata, retele amfifile, molecule amfifile care poseda capacitate de autoasambare in apa, materiale cu biodegradabilitate ridicata, construirea de arhitecturi supramoleculare bine definite.

Rezultate:

- G. Stiubianu, C. Racles, M. Cazacu, B. C. Simionescu: Silicone-modified cellulose. Crosslinking of the cellulose acetate with poly[dimethyl(methyl-H)siloxane] by Pt-catalyzed dehydrogenative coupling, J. Mater. Sci. - acceptata
- George Stiubianu, Cristian Grigoras, Carmen Racles, Maria Cazacu: New materials developed on the cellulose and siloxane derivatives. Preparation and properties evaluation Comunicare - *International Conference on Materials Science and Engineering, February 26-28, 2009, Brasov, Romania*

LUCRARI APARUTE / ACCEPTATE

Reviste cotate ISI

1. C. Racles, M. Cazacu, A. Ioanid, A. Vlad, Micellization of a siloxane-based segmented copolymer and its use as a tool for metal complex nanoparticles, **Macromol. Rapid Commun.** 2008, 29, 1527–1531 (FI = 3,383)
2. M. Cazacu, A. Vlad, A. Airinei, M. Alexandru: Silica encapsulating lanthanum complexes using the sol-gel technique, **Polym. Int.** 57: 1067-1074, 2008 (FI= 1,557).
3. A. Vlad, M. Cazacu, G. Munteanu, A. Airinei, P. Budruga: Polyazomethines derived from polynuclear dihydroxyquinones and siloxane diamines, **Eur. Polym. J.** 44, 2668-2677, 2008 (FI = 2,248).
4. C. Racles, M. Alexandru, M. Cazacu, A. Ioanid, T. Hamaide: Obtention des elastomeres silicones en nanoreacteurs siloxane-organiques; **Rev. Roum. Chim.** –2009, 54(7), 583–588 (FI=.0,208)
5. E. Avram, V. Cozan: Modified polysulfones with N-phenacyl and N-acetoxyalkyl-4,4'-bipyridinium pendant groups, **Materiale Plastice** 45 (3), 2008, 241-245 (FI = 0,404).
6. Carmen Racles, Maria Cazacu, Gabriela Hitruc, Thierry Hamaide: On the feasibility of chemical reactions in the presence of siloxane-based surfactants; **Colloid Polym Sci** (2009) 287:461–470 (FI =1,62).
7. Vasile Cozan, Mihaela Avadanei, Elena Perju, Daniel Timpu: FTIR investigations of phase transitions in an asymmetric azomethine liquid crystal; **Phase Transitions** 82 (8), 2009, 607 – 619 (FI = 1,201).
8. Maria Cazacu, Carmen Racles, Anton Airinei, Mihaela Alexandru, Angelica Vlad: Association Phenomena of the Ferrocenylsiloxane Polyamide in Solution, **Journal of Polymer Science: Part A: Polymer Chemistry**, Vol. 47, 5845–5852 (2009) (FI=3,821).
9. Carmen Racles, Anton Airinei, Iuliana Stoica, Aurelia Ioanid: Silver nanoparticles obtained with a glucose modified siloxane surfactant, **J Nanopart Res**;in press DOI 10.1007/s11051-009-9780-1 (FI=2,299)
10. M. Alexandru, C. Racles, M. Cazacu : Siloxane-organic hybrids. Evaluation of some surface properties by tensiometry, **Journal of Optoelectronics and Advanced Materials - Symposia**, Vol. 1, No. 6, 2009, p. 1095 - 11002.
11. G. Stiubianu, C. Racles, M. Cazacu, B. C. Simionescu: Silicone-modified cellulose. Crosslinking of the cellulose acetate with poly[dimethyl(methyl-H)siloxane] by Pt-catalyzed dehydrogenative coupling, **J. Mater. Sci.**_acceptata

COMPUSI SILOXANICI CA PRECURSORI PENTRU NANOMATERIALE

Capitole in carti la edituri din strainatate

1. C. Racles: Siloxane-Containing Liquid Crystalline Polymers, in *Advances in Functional Heterochain Polymers*, (M. Cazacu –Ed.), Nova Science Publishers, 2008. ISBN: 978-1-60456-599-7.
2. Carmen Racles: Polysiloxanes and siloxane-organic copolymers for nanotechnologies; in *Functional Polymeric Materials Designed for Hi-Tech Applications*, (M.Nechifor ,Ed.) Ed. Research Signpost, Kerala, India, acceptata 2010: ISBN: 978-81-7895-448-6.
3. V. Cozan, M. Ciobanu, L. Marin: Aromatic copoly(ethersulfone)s, in *Functional Polymeric Materials Designed for Hi-Tech Application* (M.Nechifor ,Ed.), Ed. Research Signpost, Kerala, India, acceptata 2010: ISBN: 978-81-7895-448-6.
4. Carmen Racles, Thierry Hamaide, Etienne Fleury : Siloxane-containing compounds as polymer stabilizers; in *Polymer Research Developments: Amphiphilic Block Copolymers, Polymer Aging, Block Copolymers/Polymer Stabilizers*, (Liudvikas Segewicz, Marijus Petrowsky –Eds.), Nova Science Publishers; https://www.novapublishers.com/catalog/product_info.php?products_id=9265

COMPUSI SILOXANICI CA PRECURSORI PENTRU NANOMATERIALE

Comunicari la manifestari stiintifice:

1. C. Racles, M. Cazacu, A. Ioanid, A. Vlad: Synthesis of polymer nanoparticles in siloxane-containing nanoreactors, Comunicare *6th International Symposium Molecular Order and Mobility in Polymer Systems –St. Petersburg, iunie 2008*
2. C. Racles, M. Cazacu, A. Ioanid: Siloxane-containing surfactants and their use for stabilization of nanoparticles, Poster- *22nd General Conference of the Condensed Matter Division of the EPS (CMD22) Roma, august 2008*
3. Mihaela Alexandru, Carmen Racles, Maria Cazacu: Siloxane-organic hybrids. Evaluation of some surface properties by tensiometry Comunicare - *International Conference on Materials Science and Engineering, February 26-28, 2009, Brasov, Romania*
4. George Stiubianu, Cristian Grigoras, Carmen Racles, Maria Cazacu: New materials developed on the cellulose and siloxane derivatives. Preparation and properties evaluation Comunicare - *International Conference on Materials Science and Engineering, February 26-28, 2009, Brasov, Romania*
5. Carmen Racles, Anton Airinei, Iuliana Stoica, Aurelia Ioanid : Nanoparticules d'argent obtenues avec des tensioactifs siloxanes ; Comunicare – *9-eme Colloque Franco-Roumain sur les Polymeres, 27-29 august 2009, Alba Iulia.*

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

**Petru Poni Institute of
Macromolecular Chemistry,
Iasi**

**National
University Research
Council**

PNCDI II – *IDEAS* Program

Project ID_233

Contract no. 5/28. 09.2007

Running period: 1 oct. 2007 – 30 sept. 2010

Total budget (initial): 750 000 RON

Total budget (approved): 632 700 RON

Principal investigator: Dr. Carmen Racles

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

Project team

Dr. Carmen Racleş - principal investigator

Dr. Maria Cazacu

Dr. Vasile Cozan

Dr. Aurelia Ioanid

PhD students:

Mihaela Alexandru

George Stiubianu

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

Project abstract

Starting from the incompatibility of polysiloxanes with most of the organic polymers, the project aims to increase the knowledge on tailoring the biphasic morphology in siloxane-containing systems, in order to obtain nanostructured materials with special properties and potential top-field applications. We will try to bring new insights into the structure-morphology - properties relationships of siloxane-containing multifunctional materials. New organo-siloxane systems (copolymers, polymer blends, polymer-dispersed systems) will be obtained and studied to observe nano-organization in solid state, in melt or in solution and to understand the influence of the biphasic morphology over bulk and surface properties. The synthesis of siloxane-containing copolymers with various architectures will be realized by polycondensation or polyaddition reactions, starting from preformed macromers. The structures will be confirmed by spectral methods (NMR, FT-IR) and their properties will be investigated by DSC, DMA, UV-VIS spectroscopy, polarized light POM. The biphasic morphology and nanostructuration will be evidenced by TEM, SEM, AFM, XRD and XPS. The potential of siloxane based surfactants or liquid crystals as nanoreactors or nanocontainers will be investigated. We will test the preparation of nano-objects, including polymeric nanoparticles, by nanoprecipitation or polymerization / polycondensation reactions in nanoreactors consisting of biphasic organo-siloxane supramolecular assemblies. The results will be evaluated for subsequent use as disperse phase in polymer blends and as delivery vehicles. Mostly biocompatible / biodegradable materials will be designed and water-based formulations for medical and personal care use will be explored.

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

General objective: *the increase of knowledge on tailoring the biphasic morphology in siloxane-containing systems, in order to obtain nanostructured materials.*

Specific objectives:

- to synthesize new bi/multiphase siloxane-containing systems (copolymers, polymer blends, polymer- dispersed systems) and to study them from the morphological standpoint, in order to understand the influence of biphasic morphology over bulk and surface properties;
- to test unconventional approaches such as siloxane-based nanoreactors for the synthesis of nano-objects;
- to use polymeric nanoparticles (nano-objects) for unconventional purposes (for example as disperse phase);
- to explore water-based formulations containing siloxane-based nanoreactors and nano-containers for targeted applications, such as drug delivery systems, coatings, paints, personal care.

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

PROJECT BUDGET (RON)

NR.	Budget Chapter	TOTAL VALUE 2007 (RON)	TOTAL VALUE 2008 (RON)	TOTAL VALUE 2009 (RON)	TOTAL VALUE 2010 ² (RON)	TOTAL VALUE (lei)
1.	PERSONNEL COSTS	29000	120000	84211	100000	333211
2.	INDIRECT COSTS	18571	71428	36875	42550	169424
3	MOBILITIES	0	10000	1146	3000	14146
4.	LOGISTICS	17429	48572	25268	24650	115919
5.	TOTAL	65000	250000	147500	170200	632700

1- Aproved Budget

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

2007

Proposed objectives

1. Synthesis of multifunctional siloxane compounds
2. Characterization of the organo-siloxane compounds

Results

- New organic mesogenic presursors;
- Organo-siloxane copolymers with chelate groups;
- Siloxane copolymers with functional pendant groups;
 - obtained by condensation reactions on the backbone;
 - obtained by addition reactions (hydrosilylation);
- Multifunctional nanoporous compounds.

- Structural characterization by spectral methods;
- Thermal / thermotropic characterization.

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

2008

Proposed objectives

1. Study of the morphology of biphasic polymers containing siloxane units;
2. Synthesis of amphiphilic siloxane compounds
3. Characterization of siloxane surfactants

Results

- Electron microscopy and AFM observations for siloxan-organic segmented copolymers and amphiphilic co-networks;
- Synthesis and characterization of new siloxan-organic amphiphilic compounds – potentially non-ionic surfactants – having various architectures (linear or cyclic macromers, copolymers with pendant functional groups) and hydrophilic units derived from monosaccharides or THMAM;
- Investigation of water soluble amphiphilic compounds regarding their surface properties and their potential for nanoparticles stabilization (preliminary tests by nanoprecipitation and chemical reactions).

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

2009

Proposed objectives

1. Preparation of polymeric nanoparticles by physical methods
2. Polymer syntheses in siloxane nanoreactors
3. Dimensional characterization of the obtained nanoparticles

Results

- Metal complex nanoparticles, as a result of self-assembling of siloxane-containing segmented copolymers in selective solvents
- Study of chemical reactions in aqueous medium, in the presence of siloxane surfactants with original structures, in order to obtain nanoparticles
- Dimensional and stability investigations of particles obtained in different surfactant – polymer systems.

Young researchers (PhD students)

MIHAELA ALEXANDRU (Ph.D. Student starting 2006), PhD without attendance, with 100% involvement degree (2007-2009).

Thesis title: Siloxane-organic siloxane-inorganic crosslinked structures obtained by sol-gel technique.

Results within the project

1. M. Cazacu, A. Vlad, A. Airinei, M. Alexandru: Silica encapsulating lanthanum complexes using the sol-gel technique, *Polym. Int.* 57: 1067-1074, 2008.
2. C. Racles, M. Alexandru, M. Cazacu, A. Ioanid, T. Hamaide: Obtention des elastomeres silicones en nanoreacteurs siloxane-organiques; *Rev. Roum. Chim.* –2009, 54(7), 583–588.
3. Maria Cazacu, Carmen Racles, Anton Airinei, Mihaela Alexandru, Angelica Vlad: Association Phenomena of the Ferrocenylsiloxane Polyamide in Solution, *Journal of Polymer Science: Part A: Polymer Chemistry*, Vol. 47, 5845–5852 (2009)
4. M. Alexandru, C. Racles, M. Cazacu : Siloxane-organic hybrids. Evaluation of some surface properties by tensiometry, *Journal of Optoelectronics and Advanced Materials - Symposia*, Vol. 1, No. 6, 2009, p. 1095 - 11002.
- 5) M. Alexandru, M. Cazacu, C. Racles, C. Grigoras: Amphiphile polydimethylsiloxane-based networks reinforced with in situ generated silica- submitted to *Polymer Engineering and Science*
- 6) Mihaela Alexandru, Carmen Racles, Maria Cazacu: Siloxane-organic hybrids. Evaluation of some surface properties by tensiometry *Comunicare - International Conference on Materials Science and Engineering, February 26-28, 2009, Brasov, Romania*

GEORGE STIUBIANU (PhD student starting 2007) – PhD without attendance; involvement degree 100% (nov.2007-2009).

Thesis title: Hybrid materials based on siloxanes and ligno-cellulose derivatives

Results within the project:

- G. Stiubianu, C. Racles, M. Cazacu, B. C. Simionescu: Silicone-modified cellulose. Crosslinking of the cellulose acetate with poly[dimethyl(methyl-H)siloxane] by Pt-catalyzed dehydrogenative coupling, *J. Mater. Sci.* - accepted
- George Stiubianu, Cristian Grigoras, Carmen Racles, Maria Cazacu: New materials developed on the cellulose and siloxane derivatives. Preparation and properties evaluation Comunicare - *International Conference on Materials Science and Engineering, February 26-28, 2009, Brasov, Romania*

Published or accepted articles -ISI

1. C. Racles, M. Cazacu, A. Ioanid, A. Vlad, Micellization of a siloxane-based segmented copolymer and its use as a tool for metal complex nanoparticles, **Macromol. Rapid Commun.** 2008, 29, 1527–1531
2. M. Cazacu, A. Vlad, A. Airinei, M. Alexandru: Silica encapsulating lanthanum complexes using the sol-gel technique, **Polym. Int.** 57: 1067-1074, 2008.
3. A. Vlad, M. Cazacu, G. Munteanu, A. Airinei, P. Budruga: Polyazomethines derived from polynuclear dihydroxyquinones and siloxane diamines, **Eur. Polym. J.** 44, 2668-2677, 2008.
4. C. Racles, M. Alexandru, M. Cazacu, A. Ioanid, T. Hamaide: Obtention des elastomeres silicones en nanoreacteurs siloxane-organiques; **Rev. Roum. Chim.** –2009, 54(7), 583–588.
5. E. Avram, V. Cozan: Modified polysulfones with N-phenacyl and N-acetoxyalkyl-4,4'-bipyridinium pendant groups, **Materiale Plastice** 45 (3), 2008, 241-245.
6. Carmen Racles, Maria Cazacu, Gabriela Hitruc, Thierry Hamaide: On the feasibility of chemical reactions in the presence of siloxane-based surfactants; **Colloid Polym Sci** (2009) 287:461–470.
7. Vasile Cozan, Mihaela Avadanei, Elena Perju, Daniel Timpu: FTIR investigations of phase transitions in an asymmetric azomethine liquid crystal; **Phase Transitions** 82 (8), 2009, 607 – 619.
8. Maria Cazacu, Carmen Racles, Anton Airinei, Mihaela Alexandru, Angelica Vlad: Association Phenomena of the Ferrocenylsiloxane Polyamide in Solution, **Journal of Polymer Science: Part A: Polymer Chemistry**, Vol. 47, 5845–5852 (2009)
9. Carmen Racles, Anton Airinei, Iuliana Stoica, Aurelia Ioanid: Silver nanoparticles obtained with a glucose modified siloxane surfactant, **J Nanopart Res**;in press DOI 10.1007/s11051-009-9780-1
10. M. Alexandru, C. Racles, M. Cazacu : Siloxane-organic hybrids. Evaluation of some surface properties by tensiometry, **Journal of Optoelectronics and Advanced Materials - Symposia**, Vol. 1, No. 6, 2009, p. 1095 - 11002.
11. G. Stiubianu, C. Racles, M. Cazacu, B. C. Simionescu: Silicone-modified cellulose. Crosslinking of the cellulose acetate with poly[dimethyl(methyl-H)siloxane] by Pt-catalyzed dehydrogenative coupling, **J. Mater. Sci.**_accepted

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

Book chapters

1. C. Racles: Siloxane-Containing Liquid Crystalline Polymers, in *Advances in Functional Heterochain Polymers*, (M. Cazacu –Ed.), Nova Science Publishers, 2008. ISBN: 978-1-60456-599-7.
2. Carmen Racles: Polysiloxanes and siloxane-organic copolymers for nanotechnologies; in *Functional Polymeric Materials Designed for Hi-Tech Applications*, (M.Nechifor ,Ed.) Ed. Research Signpost, Kerala, India, accepted 2010: ISBN: 978-81-7895-448-6.
3. V. Cozan, M. ciobanu, L. Marin: Aromatic copoly(ethersulfone)s, in *Functional Polymeric Materials Designed for Hi-Tech Application* (M.Nechifor ,Ed.), Ed. Research Signpost, Kerala, India, accepted 2010: ISBN: 978-81-7895-448-6.
4. Carmen Racles, Thierry Hamaide, Etienne Fleury : Siloxane-containing compounds as polymer stabilizers; in *Polymer Research Developments: Amphiphilic Block Copolymers, Polymer Aging, Block Copolymers/Polymer Stabilizers*, (Liudvikas Segewicz, Marijus Petrowsky –Eds.), Nova Science Publishers; https://www.novapublishers.com/catalog/product_info.php?products_id=9265

SILOXANE-BASED COMPOUNDS AS PRECURSORS FOR NANOMATERIALS

Communications

1. C. Racles, M. Cazacu, A. Ioanid, A. Vlad: Synthesis of polymer nanoparticles in siloxane-containing nanoreactors. Oral communication *6th International Symposium Molecular Order and Mobility in Polymer Systems –St. Petersburg, June 2008*
2. C. Racles, M. Cazacu, A. Ioanid: Siloxane-containing surfactants and their use for stabilization of nanoparticles, Poster- *22nd General Conference of the Condensed Matter Division of the EPS (CMD22) Roma, August 2008*
3. Mihaela Alexandru, Carmen Racles, Maria Cazacu: Siloxane-organic hybrids. Evaluation of some surface properties by tensiometry. Oral communication - *International Conference on Materials Science and Engineering, February 26-28, 2009, Brasov, Romania*
4. George Stiubianu, Grigoras Cristian, Carmen Racles, Maria Cazacu: New materials developed on the cellulose and siloxane derivatives. Preparation and properties evaluation. Oral communication - *International Conference on Materials Science and Engineering, February 26-28, 2009, Brasov, Romania*
5. Carmen Racles, Anton Airinei, Iuliana Stoica, Aurelia Ioanid : Nanoparticules d'argent obtenues avec des tensioactifs siloxanes ; Oral communication – *9-eme Colloque Franco-Roumain sur les Polymeres, 27-29 August 2009, Alba Iulia.*