

ACTIVITY REPORT

**NEW NANOCOMPOSITES BASED ON BIOCOMPATIBLE POLYMERS AND
GRAPHENE FOR DENTAL APPLICATIONS - BIOGRAF (230/2014)**

Project Coordinator

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Work package 3 (2016)

**Technical documentation. Patent elaboration.
Biological studies.**

A 3.1 Preparation of graphene-based nanofillers and their morphological and structural characterization (CO-INCDTIM)

Due to its low cytotoxic effect, graphene-oxide (OG) was selected for addition in dental materials. After preparation, it was combined with oxidic materials (SiO_2 and ZrO_2) and the corresponding composite materials (OG- SiO_2 and OG- ZrO_2) were morphologically (TEM) and structurally (XRD ; FTIR ; UV-Vis) characterized. After that, they were used as nanofillers (in low concentrations) in dental materials.

A 3.2 Optimization of graphene-oxide synthesis (CO-INCDTIM)

The final parameters and the reaction conditions for graphene-oxide synthesis were established. The optimized method was developed. The method ensures the synthesis of graphene oxide having the desired morphological and structural characteristics: thin and transparent sheets (11-12 layers); inter-layer distance ~ 0.8 nm.

A 3.3 Optimization of dental materials synthesis (P1-UBB)

Dental materials with composite materials OG- SiO_2 or OG- ZrO_2 were synthesized and the optimized conditions were established :

- ✓ The optimum ratio between the organic and anorganic fillers was 20/80;
- ✓ In order to fulfill the esthetic requirements, low quantities of OG- SiO_2 or OG- ZrO_2 were used (0.2 - 0.3 wt%)
- ✓ The optimum time for mixing the organic with the anorganic fillers was 8 hours;
- ✓ The optimum photopolymerization time was 40 s

A 3.4 Patent elaboration (P1-UBB ; CO-INCDTIM)

1. A patent request was submitted to OSIM : ‘Composite material containing graphene oxide and used for dental restoration’ by Marioara Moldovan, Stela Pruneanu, Crina Socaci, Marcela Rosu, Codruta Sarosi, Stanca Cuc, Doina Prodan (**OSIM No.** A/00902/24.11.2016)

A 3.5 Finalizing the biological studies (in vitro): experimental model for testing the adhesion of new restorative materials to the dental hard tissues; electron microscopy and optical microscopy on extracted human teeth (P2-UMF)

The study aimed to evaluate the marginal infiltration on extracted teeth. 15 extracted teeth were included in the study. The teeth were divided into 3 groups of five teeth: *Group 1* - for cavity filling, a material based on graphene oxide and ZrO_2 (GZ2) was used; *Group 2* - for cavity filling, a material based on graphene oxide and SiO_2 (GS4) was used; *Group 3* – the teeth were filled with a light-curing composite trade as Amelogen Plus (Ultradent Products, Inc. USA). The results indicated a

score 0 - lack of marginal infiltration, when restoration was performed with GZ2 composite and the commercial Amelogen Plus (*Group 1 and Group 2*). In the case of restoration with the GS4 composite, a marginal infiltration was observed (*score 1- Group 3*).

A 3.6 The feasibility study for industrial research - Part I (P3-Apel Laser SRL)

The feasibility study was elaborated by APEL LASER SRL. The study aimed to provide the appropriateness of introducing into production of a composite material based on biocompatible polymers and graphene, for dental applications.

Act. 3.7 Disemination of the research results to PhD students and PostDoc (CO-INCDTIM; P1-UBB; P2- UMF) PhD students and PostDoc were actively involved in most of the research activities.

ISI Papers:

1. Codruta Sarosi, Alexandru Radu Biris, Aurora Antoniac, Stanca Boboia, Camelia Alb, Iulian Antoniac and Marioara Moldovan, “*The nanofiller effect on properties of experimental graphene dental nanocomposites*”, Journal of Adhesion Science and Technology, 2016, VOL. 30, NO. 16, 1779–1794 (**IF 0.863**) (**P1, P2, CO**)
2. A. MUNTEAN, A. MESAROS, D. FESTILA, M. MOLDOVAN, M. MESAROS, “*In Vitro Microleakage Evaluation Around Three Types of Dental Sealants*”, MATERIALE PLASTICE, Vol.53, No.1, 2016, 166-169 (**IF 0.903**) (**P1**)
3. M-C Rosu, C Socaci, V Floare-Avram, G Borodi, F Pogacean, M Coros, L Magerusan and S Pruneanu, *Photocatalytic performance of graphene/TiO₂-Ag composites on amaranth dye degradation*, Materials Chemistry and Physics 179 (2016) 232-241 (**IF 2.102**) (**CO**)
4. C. Socaci, F.Pogacean, A.R.Biris, M.Coros, M.C.Rosu, L.Magerusan, G.Katona, S. Pruneanu, *Graphene oxide vs. Reduced graphene oxide as carbon support in porphyrin peroxidase biomimetic nanomaterials*, Talanta, 148(2016)511–517 (**IF 4.035**) (**CO**)

Book-chapter

1. ‘*Efectul diferitelor bauturi asupra stabilitatii culorii nanocompozitelor experimentale cu grafene*’ Codruta Sarosi, Marcela-Corina Rosu, Cristina Prejmerean, Laura Silaghi-Dumitrescu, Stanca Cuc, Doina Prodan, Marioara Moldovan, pg. 95-101, in ‘**Cercetarea in Medicina dentara- proprietati optice ale dintilor si materialelor dentare**’, Colorama- Cluj-Napoca; ISBN 606877815-0 (**P1; CO**)

Patent

1. ‘Composite material containing graphene oxide and used for dental restoration’ M. Moldovan, S. Pruneanu, C. Socaci, M. C. Rosu, C. Sarosi, S. Cuc, D. Prodan (**P1, CO**)- **submitted to OSIM** (A/00902/24.11.2016)

Conferences

1. **CNB 2016**, National Conference of Biophysics, 2-4 iunie, **2016**, Cluj-Napoca, Romania - *Graphene oxide-based composites as biocompatible substrates for cell adhesion and proliferation*, M.C. Rosu, C. Socaci, L. Magerusan, F. Pogacean, M. Coros, E. Pall, S. Pruneanu (CO)
2. **CNB 2016**, National Conference of Biophysics, 2-4 iunie, **2016**, Cluj-Napoca, Romania - *Peroxidase biomimetic materials based on porphyrin and graphene/graphene oxide*, S. Pruneanu, C. Socaci, F. Pogacean, M. Coros, L. Magerusan, M.C. Rosu (CO)
3. International Symposium of Dentistry Napoca Biodent 2016, 9-10th May 2016, Cluj-Napoca, Romania, *The effect of different drinks on the color stability of graphene experimental nanocomposites*, C. Sarosi, M. Rosu, C. Prejmerean, L. Silaghi-Dumitrescu, S. Cuc, D. Prodan, M. Moldovan- *Prezentare orală* (P1; CO)
4. SCAD 2016: 8th Annual Conference of Society for Color and Appearance in Dentistry Chicago, IL, 15-17 Septembrie 2016, *Color change of some experimental nanocomposites after accelerated aging test*, C. Sarosi, M. Rosu, C. Prejmerean, L. Silaghi-Dumitrescu, M. Moldovan (P1; CO)

General Conclusions

All the activities foreseen within this work-package were accomplished:

- D7- Material/Patent
- D8- Technical data
- D9- Biological studies
- *4 ISI papers were published*
- *1 book-chapter was published*
- *1 Patent was submitted to OSIM (nov. 2016)*