RUSSIP -Russian and Spanish Innovation Program -
Project partners search form

Contract Person Details	
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Organization Details:			
Name: IMDEA Materials Institute (**in collaboration with a Russian SME NanoMet Ltd.)**			
Country: Spain	Website: http://www.materiales.imdea.org/		
Type of Organization:	[ ] SME [X] Research Inst.	[ ] Large Company [ ] Administration	[ ] University [ ] Other (specify):
Number of Employees:	[ ] < 10 [ ] 101-250	[ ] 11-50 [ ] > 250	[X] 51-100

Describe the activities, products, services, and expertise of your organization:

About IMDEA Materials:
The main objective of IMDEA Materials is technology transfer to industry to increase competitiveness and maintain technological leadership in the following areas:

- Nanomaterials for Multifunctional Applications
- The Next Generation of Composite Materials
- Alloy Design, Processing and Development
- Integrated Computational Materials Engineering
- Multiscale Characterization of Materials and Processes

About the Russian SME **NanoMet Ltd**.: http://nanospd.ru/eng/nanomet%20ltd.html

The Russian SME NanoMet Ltd. was founded in 2007 as a spin off of Ufa State Aviation Technical University (Ufa, Russia). The company's objective was to organize the first in the world pilot-commercial production of semi-products (rods) from nanostructured titanium for medical applications. Since 2010, NanoMeT has been commercially producing semi-products (rods) for nanostructured titanium for medical applications in compliance with the registered Technical Specifications (TU 1825 – 001 – 02069438 – 2010). These semi-products are intended for making dental implants and are in demand by manufacturers of dental implants.

In 2012 NanoMeT received an international ISO 9001:2008 certificate for its quality management system. The certificate was issued by TÜV SÜD Management Service GmbH (Munich, Germany), certificate registration number 12 100 43097 TMS. In February-March 2015 NanoMeT successfully passed a recertification audit by TÜV SÜD Management Service GmbH. To date, NanoMeT has mastered the production of long-length rods (over 2 m in length) with a diameter of 3 -6 mm. The estimated production capacity is 2.5 tons per year. Currently, NanoMet Ltd. is developing processing routes for manufacturing of high strength conductors (wires and cables) from Cu and Al-based materials

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Project Details

Project Title	Spanish: Desarrollo de materiales de Ti puro o base Ti nanoestructurados con propiedades mecánicas y funcionales mejoradas para implantes biomédicos avanzados English: Development of nanostructured high strength pure Ti and Ti-based materials with improved mechanical and functional surface properties for advanced biomedical implants
Keywords	Ti-based materials, nanostructure, deformation processing, fatigue, surface design, quick biointegration.

Describe your Project:
Spanish:

El objetivo principal del proyecto es **desarrollar un nuevo enfoque de tecnologías de procesado (basado en procesado por Deformación Plástica Severa (SPD) seguido de acondicionamiento de la superficie) para obtener nanomateriales de base Ti con mejores propiedades mecánicas (resistencia, fatiga) y funcionales en la superficial (bioactividad, osteointegración, etc) para la fabricación de implantes biomédicos**. Las propiedades mecánicas serán mejoradas mediante nanoestructuración de materiales masivos, mientras que el diseño superficial será aplicado para mejorar todavía más las propiedades funcionales de la superficie (bioactividad, osteointegración, etc) de estos materiales. La mejora de la resistencia mecánica permitirá reducir el tamaño de los implantes biomédicos por lo que se disminuirá el nivel del daño del cuerpo durante su inserción en el cuerpo humano (implantes dentales) o reducir el nivel de molestia durante el tratamiento (arcos). La mejora de las propiedades funcionales permitirá una osteointegración más rápida de los implantes y una reducción del periodo de rehabilitación de los pacientes.
El proyecto incluirá diferentes tareas:

- Diseño inteligente nanoestructural para mejorar las propiedades mecánicas de materiales de base Ti mediante procesado avanzado por SPD.
- Caracterización mecánica detallada de los nanomateriales de base Ti fabricados.
- Ajuste superficial mediante grabado usando varias disoluciones químicas y/o crecimiento de nanorecubrimiento avanzado para incrementar la bioactividad de la superficie.
- Caracterización detallada de las propiedades funcionales de los materiales de base Ti (bioactividad, osteointegración, etc).
- Experimentos *in vitro* e i*n vivo* usando implantes médicos piloto hechos a partir de los nanomateriales de base Ti desarrollados con superficies con propiedades óptimas.

English:
The main objective of this project is **to develop novel approach for processing technologies (based on SPD processing followed by surface tailoring) for fabrication of Ti-based nanomaterials with enhanced mechanical (strength, fatigue life) and surface functional (bioactivity, osteointrgration, etc.) properties for manufacturing of novel biomedical implants.** Mechanical properties will be improved via nanostructuring of materials in bulk, whereas additional surface design will be also applied to further improve surface functional properties (biocompatibility, osteogenesis, etc.) of these materials. Improved mechanical strength will allow to reduce the size of biomedical implants, thus decreasing the level of body damage during their insertion into human body (dental implants) or reduce the level of discomfort during treatment (archwires). The improved functional properties will allow much quicker osteointegration of implants and reduce the rehabilitation period of patients.
The **project** will include several tasks:

- Intelligent nanostructural design to increase mechanical properties of Ti-based materials via advanced SPD processing.
- Detailed mechanical characterization of the manufactured Ti-based nanomaterials.
- Tailoring surface via etching using various chemical solutions and/or growth of advanced nanocoatings to increase surface bioactivity.
- Detailed characterization of functional properties of the Ti-based materials (bioactivity, osteointegration, *etc.*).
- *In vitro* and i*n vivo* experiments using pilot medical implants made from the developed Ti-based nanomaterials with tailored surfaces.

Describe the innovative part of your project:

The originality of the project lies in the combined approach to microstructural design to simultaneously improve mechanical and functional properties of Ti-based materials for biomedical industry. The existing technologies have been developed either to improve the surface functional properties of conventional biomaterials having ordinary mechanical strength, or to increase mechanical strength of biomaterials without any surface design. **The project aims to take step ahead via combination of both approaches:** (1) nanostructuring using novel SPD processing routes to improve mechanical properties, which is followed by (2) intelligent surface design to enhance bioactivity and osteointegration of the surface. The improved mechanical properties will allow to reduce the size of the biomedical implants. The enhanced bioactivity will allow a quick healing of patient after surgery or an immediate loading of dental implants after inserting dental implant into jaw.

Describe the market expectations of your project:

The dental implants and prosthetics market has experienced a widespread growth in the past few years, and these markets are poised for more extensive growth in the forthcoming years. The global dental implants and prosthetics market is estimated to be worth **$6,401.5 million** in 2015. Titanium implants as well as crowns and bridges will continue to drive and dominate the global market in the near future. Europe is the region of origin of implant dentistry; its share in dental implants and prosthetics is around 42% of the global market. This share was valued at **$1,016 million** in 2015, and is expected to be $2,065 million by 2018, at a CAGR of 6.5% during the forecast period, 2013 to 2018.
Europe will continue its leadership in the dental implants and prosthetics market. The market share of Europe will decrease slightly to 40.1%, primarily due to the increase in demand for dental implants and prosthetics in Asia-Pacific and some Latin American countries. The growth of the Asian market will primarily be driven by China and India. This is mainly attributed to the rising disposable incomes, increasing focus of major players, and the ongoing development of these economies.
The outcomes of the present project will allow to the producers of the biomedical implants, involved in the project, to open a new niche in the market of the biomedical implants, namely, advanced biomedical implants of reduced size with enhanced bioactivity and quick biointegration into human body. Currently, the only producer of such biomedical implants, the small enterprise TIMPLANT from Ostrava (Czech Republic) http://www.timplant.cz/en/ is successfully occupying the local market and cannot expand it due to the small size of the company. However, no such products are offered in the north, central and south parts of Europe that presents a good opportunity for manufacturers of biomedical implants.

Possible Partner Profile:

Type of Partner Needed (multiple choices are allowed)	[X] SME	[X] Larger Company
	[ ] University	[ ] Research Institution
	[ ] Administration	[ ] Other (specify):

Describe the expertise of possible partner(s) required for your project:

• Experience in manufacturing of biomedical implants.
Describe the role of possible partner(s) in your project: Spanish: • Fabricación de implantes biomédicos a partir de materiales nanoestructurados • Optimización del diseño de implantes médicos. • Ensayos *in vitro* e *in vivo* usando implantes médicos (si el posible) English: • Manufacturing of biomedical implants from nanostructured materials. • Optimization of design (size reduction) of biomedical implants. • *In vitro* and/or *in vivo* testing of biomedical implants (if possible).