

# Newsletter 07-08. 2007

## Editorial

Dear Members,

A month is already over since our Second Review Meeting during which the EC stressed the significant improvement of EXCELL achievements. This 3<sup>rd</sup> year will be decisive for our Virtual Institute as it must set-up VINF pilot implementation. In this frame, it is time now to (re)introduce a Newsletter in our consortium. This version is an experimental monthly based version on which your comments are welcome. In advance thank you for your reading and your support in this summer time.

Sincerely,

F. Mirabella

## Como Summer school

From July 2 to 6 held the EXCELL summer school on Applications of Nano-components & Nano-materials in Como (Italy). The present students attended lectures covering different types of nanomaterials and nanofilms applications such as decorative coatings, surface hardening, low friction materials, advanced electronics and spintronic. Powerpoint files used by speakers are available for download from our web portal. (FMI - CR1)



## Nanosmat Conference



From July 9 to 12 held the second edition of International conference on Surface, coatings and nanostructured materials (Nanosmat) in Portugal. Carlo Patternoster presented oral contribution on EXCELL collaborative work on CrN<sub>x</sub> coatings and was awarded the best contribution in the session "Surface Science: from bulk to nanoscale". The conference covered very broad area of nano's and their applications. Four parallel sessions concerned with Carbon Nanotubes, Manufacturing... cohabitated with variable efficiency. Although the scientific quality of the conference was very high, most of attendees were a little bit disappointed about the organisation. (FMI - CR1)

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# Brief from EXCELL

## ARM Meeting commitment

When presenting the next 18 months program, it was decided to consider the following targets to monitor performances at the next ARM:

- mobility of students / researchers : 2 people spending 1 month (or equivalent such as 4 people spending 2 weeks...) by another partner
- variety of partners visited by them : exchanges with at least 2 different partners
- promotion of EXCELL / VINF towards 2 possible satellite partner
- 3 new joint publication
- Variety of joint publication : all in all having published with 4 different partners
- Involvement in 1 new joint research project
- Organisation and participation in 1 EXCELL event
- Promotion of VINF to SME's and companies

## VINF Logo

A contest among EXCELL people is open to design the logo of our Virtual Institute. Proposals have to be sent to F. Mirabella who will present them anonymously to the General Assembly for voting. The author of the chosen logo will have his registration to Budapest Conference offered by VINF. Today only two logo proposals have been submitted. Deadline is September 1<sup>st</sup>.

## Budapest Conference

The registration to the International Conference on Functional Coatings we organised is open. Deadline for abstract submission is December 15<sup>th</sup> and all of us are invited to promote this event and send to Erika & Peter our friends and contact lists for diffusion of the conference flyer. All information on <http://www.chemres.hu/nanocoatings>

## The road to integrated Master program

In order to continue the set-up of a joint Master program on Nanofilms, each of us is invited to send to Asuncion rules of our particular institution concerning the recognition of such a teaching program.

## The road to Business Plan

Following exclusion of APINDUSTRIA, F. Mirabella, Ph. Chodé and F. Epicum have met the "Conseil pour l'Innovation et le Développement de l'Entreprise" (Cide) which are expert in helping new companies (technology oriented) to born and develop. As a whole, they could thus commit to deliver a good quality Business Plan within the delay defined by the EC. The discussion is now continuing on the most effective way to enter EXCELL consortium from the administrative point of view. Cide prefers to act as pure subcontractor but this has to be discussed with the EC. A meeting is foreseen with Martyn Chamberlain to fix this question in early September. In the meanwhile, following our discussion in Brussels, the morning after the ARM, all of us are asked to list items we have sold to companies over the past 5 years with average related income.



## VINF business and marketing

Lauro Pigni (CR7) visited summer school in Como to discuss business and marketing points with F. Mirabella. In order to prepare in the best way commercial components of VINF website and marketing actions to promote our Institute the following ideas were discussed:

- Definition of VINF products: what can we propose for sale on our Website?
- VINF Website architecture and content : from academic description to commercial presentation ;
- VINF presentation video : presentation of our network and Institute through a short video in which VINF people will be invited to participate ;
- Prof. VINF: spreading of excellence towards general public through a virtual character.

## Meeting with Stan Veprek

In the frame of Nanosmat conference in Portugal, F. Mirabella met Prof. Stan Veprek with whom he discussed his possible come back in EXCELL project. Back from Portugal, EXCELL members have been told about the conclusion of this discussion. On the other hand, exchanges of information about Phil Carrion past misconduct will probably give birth to a legal pursuit from EXCELL coordinator against this last.

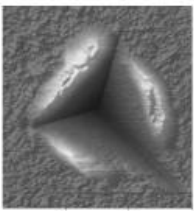


## Research Roadmap on Biocompatible

Definitive version of the EXCELL research roadmap on Biocompatible, Biofunctional and wear resistant nanostructured coatings for surgical implants have been delivered by Dmitry Shtansky (CR5). Four sub-projects are proposed:

1. *Multifunctional Bioactive Nanostructure films (MUBONAF) for load-bearing implants - Project leader CR5*
2. *Ca Phosphate Coatings for Orthopaedic and dental implants - Project leader CR3*
3. *Biocompatible Wear-resistant Nanostructured Coatings for Articulating Joint Replacements - Project leader CR8*
4. *Surface Bio-functionalization of Surgical Implants for Cell guidance and Control - Project leader CR8*

## FP7 Proposals



*Research proposal NANOINDENT coordinated by Peter Nagy (CRC - Hungary) has passed the FP7 evaluation threshold and is ranked among the first 6 (out of 15) proposals that should be funded by EC. This research proposal is part of Coordination and Support Action and involved 15 partners (5 EXCELL, 9 non EXCELL + VINF). Congratulations!*





## CVD diamond coatings on PIRAC Cr nitride interlayer coating on steel

I. Gotman<sup>1</sup>, A. Hoffmann<sup>1</sup>, R. Ahvelediani, F. Mirabella<sup>2</sup> and E.Y. Gutmanas<sup>1</sup>

<sup>1</sup>CR 8, Technion. <sup>2</sup>CR 1, Arcelor-Mittal

HSLA steel, containing 1.0 Al, 0.1Nb, 0.1V, 0.1N, 0.5 Cr, 0.4Cu, 0.3Ni and 2.5Mn and 316 L stainless steel 0.4 mm thick sheet specimens were coated by Cr nitride interlayer employing modified PIRAC - Powder Immersion Reaction Assisted Coating [1-3]. In PIRAC metal atoms are transferred to the substrate by surface diffusion and/or via gas phase - e.g. M = Cr has a very high equilibrium gas pressure. The obtained results show that PIRAC coating morphology depends on the type of steel, temperature and exposure. Examples of microstructure obtained after 1h treatment at 900 °C for 1h are in Fig.1 (SEM).

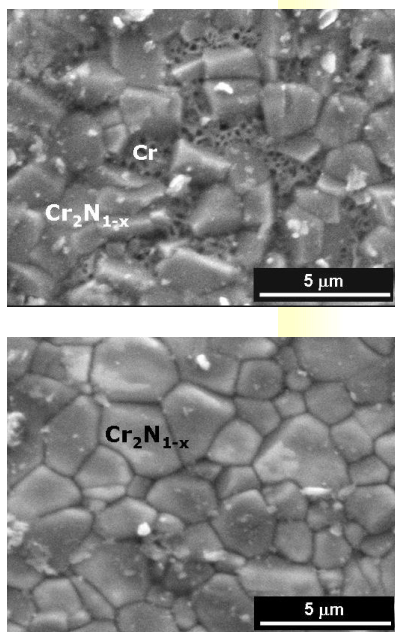


Fig. 1. SEM micrographs of Cr nitride coatings obtained after PIRAC treatment in Cr for 1h at 900 °C: (upper) HSLA steel; (lower) 316L stainless steel.

Finer structure is obtained at shorter exposures or at lower temperatures. The PIRAC treatment was followed by CVD diamond deposition at 750 °C. XRD spectrum and SEM micrograph of CVD diamond coated specimens with less than 1µm thick Cr nitride interlayer are shown in Fig.2. XRD analysis, SEM/EDS, SIMS and Auger depth profiles results suggest that diamond film deposition results in the reaction of carbon with the buffer nitride resulting

in the formation of a chromium carbide phase onto which diamond film is formed and grow.

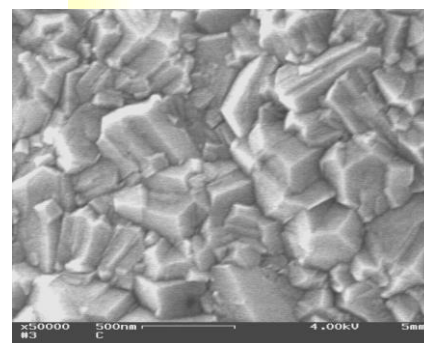
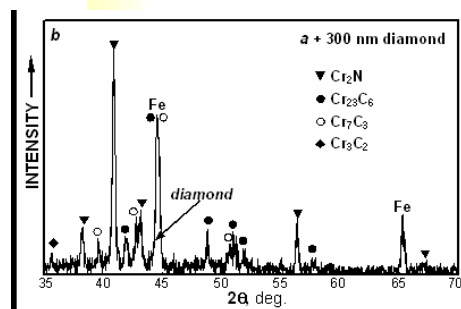


Fig. 2. XRD spectrum (upper) and SEM micrograph (lower) diamond CVD coating obtained at 750 °C on of Cr interlayer nitride obtained after PIRAC treatment in Cr for 15 min at 900 °C on 316L stainless steel.

Three point bending test show that coatings have excellent adhesion to the substrate - after plastic deformation of the substrate no delamination of the coating was observed, but only thin cracks normal to the coating surface.

### References:

1. I. Gotman and E.Y. Gutmanas, *Acta Metall. Mater.* **40S**, 121-131 (1992).
2. A. Shenhar, I. Gotman, S. Radin, P. Ducheyne and E.Y. Gutmanas, *Surface Coat. Techn.* **126**, 210-218 (2000).
3. I. Mashal, L. Klinger, I. Gotman and E.Y. Gutmanas, *Surface Coat. Techn.*, **200** 3561-3566(2006).

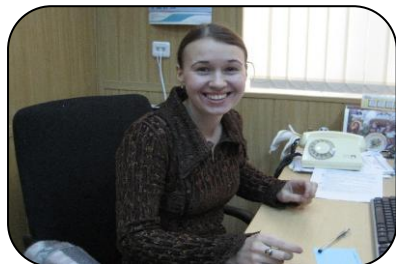
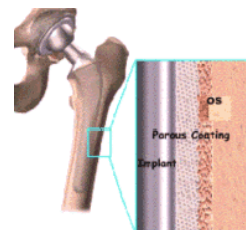
(EGU - CR8)



# VINF people

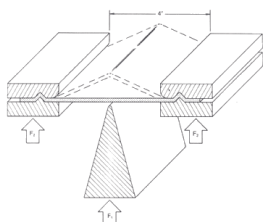
## VINF People

Graduate from Moscow State Institute of Steel and Alloys (MISA) in 2004, **Irina Bashkova** is now completing a PhD thesis on Biocompatible nanostructured coatings for load-bearing implants. She already published several papers in referred journal, from which *Biomaterials* 27, 3519 (2006) and *Surface and coatings technology* 201, 4111 (2006).



In September, she will attend Euromat 2007 conference and present her last contribution on Bioactive (Ti, Ta)-Based Ceramics Films for Implants. Among Irina's expertise domains we may stress Tribological tests, optical microscopy, contact angle measurements and scanning force microscopy.

Mechanical engineer, **Carlo Paternoster** worked for a private company before deciding in 2006 to come back at Politechnic University of Marche and start a PhD thesis on mechanical and thermal testing of coated materials. To do so, Carlo uses Grazing angle X-ray diffraction, nanoindentation, Nakazima tests, etc. Not only interested in the coating characterisations but also in their preparation, Carlo profits of EXCELL NoE to learn and practice PVD deposition with the team of Prof. A. Fernandez in Seville.



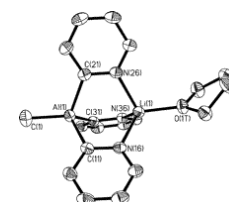
In Nanosmat 2007 conference, Carlo received a prize for the best contribution in the session "Surface Science: from bulk to nanoscale" for presenting a work on Thermal Stability of  $\text{Cr}_N$  Nanometric Coatings Deposited on Stainless Steel.

Upstream of the nanocoatings preparation is the continuous research of new nano materials. VINF is also active in this area of study, through the Chemistry Department of Cambridge University were **Michael Rogers** grew up. After a PhD thesis on Synthesis and Reactivity of New Tris-Pyridyl Complexes he decided to continue on the road of research on nanoparticles synthesis in the frame of catalytic and hydrogen storage applications.



precise idea of Michael's activities through the following publications: *Organometallics* 23, 3884 (2004), *Chem. Comm.* 298 (2005).

His expertise stands mainly on air sensitive chemistry (synthetic techniques), gas chromatography-mass spectrometry and catalytic tests. You may have more





# Potential Associate Members

This month two VIN F PAMs (Potential Associate Member) are presented. The first one is **TEKNIKER**, a research centre from northern Spain (Basque country) and the second is **PROTEC Surface Technologies**, an Italian SME active in the field of PVD and CVD decorative coatings.

**TEKNIKER** is a technological centre and legally constituted as a private not-for-profit Foundation. Its mission is to help the industrial sector to increase its innovative capacity by means of generating and applying technology and knowledge in order to be more competitive. In line with its missions and origins, TEKNIKER not only provides companies with technological support, but is also involved in generating new business initiatives, which are usually technological and, often, as "spin offs" of the centre itself. Among the example, **Millennium Coatings** spin-off has been set-up to design and produce coating machines.

In the frame of surface functionalisation, TEKNIKER has been working from its earliest days on areas involving friction, lubrication and wear. Tekniker position at the cutting edge of this field is currently borne out by its involvement in the European integrated project: "KRISTAL": knowledge-based radical innovation surfacing for tribology and advanced lubrication".

As a natural evolution of this line of action, cutting edge research is now focusing on obtaining functionalised surfaces, i.e., with the capacity to undertake functions that are predetermined, conditioned or proportionally graduated to external stimuli. Current and future applications include anti-wear, magnetic, catalytic, optics (reflective and absorbent surfaces), hydrophilic-hydrphobic.



From machinery point of view, TEKNIKER is currently the only Spanish company able to provide integral solutions to design, construction and industrialisation of coating chambers using phase vapour deposition (PVD). The company's record in this field can be traced back to 1990 and thanks to its achievements over the years, it now has its own evaporators, controlling the industrial-scale laboratory processes, a wide range of coatings and physical-chemical characteristics and high vacuum technology in line with chamber' requirements. TEKNIKER is currently a leading European benchmark in PVD, which is confirmed by its being the lead partner in FOREMOST, the European integrated project that is developing functionalised coatings using fullerenes. TEKNIKER's record includes a wide range of applications and sectors such as metal-mechanics (cutting tools, models and matrixes, self-lubricating parts), aesthetics (fixtures for tools, locks, cutlery, taps and bathroom fittings, decorative ceramics), medical (bio-compatible coatings in prosthesis).

Website: <http://www.tekniker.es>

TEKNIKER contact person: J. Barriga

VINF contact person: F. Mirabella



**PROTEC Surface Technologies** designs and produces innovative PVD machinery. Incorporating together CAE (Cathodic Arc Erosion) and MS (Magnetron Sputtering) technologies in special configurations, grants the equipment the possibility to generate astonishingly advantageous coating processes. PROTEC offers not only equipment, but also substantial "Know-How" concerning various production processes. They can supply a complete "turn key" plant inclusive of standard procedures (process recipes) to obtain a large variety of metallic colours, including the possibility to deposit precious metals such as gold and silver and/or their alloys. This and technological capability and "Know-How" has been obtained due to the continuous dedication of the personnel and by investments in research and development.



In the hereby figure are shown examples of PVD coated items such as door handles, watches or couverts. Thanks to a particular magnetron sputtering unit and the geometry and configuration of the magnetic fields, PROTEC is able to deposit any type of pure metals, alloys and all precious metals. Moreover innovative Process Control Software resulting from extensive studies with Universities and research laboratories, provides "tight" control of PVD process coating cycle parameters. Process and pre-treatment "Know-How", such as mechanical, thermal, chemical and electro-chemical technologies used to prepare substrates properly for coating, has been earned through years of "field" experience and by coating of millions of different

types of articles. With this technology, PROTEC offers coating services to third parts mainly in the field of Door hardware, Faucets and fixtures, Bathroom accessories, Optical accessories, Costume jewellery, Orthodontic and surgical equipment, Fashion accessories, Watch cases and accessories, Tool, Moulds, Dies, Car industry.

Website: <http://www.protectim.com>

PROTEC Surface Technologies contact person: F. Pitacco

VINF contact person: E. Evangelista

### Call for next month

*In the frame of our new research roadmap on biofunctional and bioactive coatings, approach of companies involved in this kind of business is of tremendous importance. VINF partners that already collaborate with such a SME or company are invited to submit "bio-orientated" candidates.*



## Publications

- Kolodziejczyk L., Martínez-Martínez D., Rojas T.C., Fernández A., Sánchez-López J.C.  
*Surface-modified Pd nanoparticles as a superior additive for lubrication*  
**Journal of Nanoparticle Research 9:639-645.**

## Contributions

### **IX International Symposium on Self-propagating High-temperature Synthesis SHS 2007, Dijon, 1-5 July 2007**

- Kudryashov A.E., Pogozhev Yu.S., Levashov E.A., Vakaev P.V., Zamulaeva E.I., Trtanj M.I.  
*Electrode materials dispersion-strengthened with nanoparticles and their use in electrospark alloying*
- Zamulaeva E.I., Levashov E.A., Kudryashov A.E., Vakaev P.V., Petrzhik M.I.  
*Influence of grain size of WC-8%Co in electrodes on chemical interaction with Ti substrate during electrospark deposition*
- Yepishko Yu.K., Levashov E.A., Senatulin B.R.  
*Development and production of new multicomponent composite targets for magnetron sputtering of biocompatible coatings using technology of self-propagating high-temperature synthesis*
- Kurbatkina V.V., Levashov E.A.  
*Dispersion hardening ceramic materials produced using SHS- pressing technology*

### **Nanosmat 2007, Algor, 9-11 July 2007**

- Denisov N., Mavrin B.N., Novikova N.N., Vinogradov E.A., Yakolev V.A., Godinho V., Fernandez-Ramos C.  
*Infrared and Raman characterization of magnetron sputtered silicon oxide and silicon oxinitride films*
- Denisov N., Mavrin B.N., Novikova N.N., Vinogradov E.A., Yakolev V.A., I. Gotman, G. Zoran  
*Vibrational spectroscopy of hexadecylphosphonic acid self-assembled monolayer on TiN coated Nitinol*
- Yakolev V.A., Mattei G., Valentini V.  
*Enhancement of the optical signal in nanoporous silicon structures: case of a hybrid metal/porous silicon microcavity*

### **18th Int. Conf. On Electromagnetic Fields and Materials, Budapest, 17-18 May 2007**

- Molnar N., Tolnai Gy., Meszaros S., Sztaniszlav D., Kalman E.  
*Preparation and characterization of Y-Fe-Al garnet nanostructured materials*





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## Recommended reading

Focussed book - recommended by Prof. E. Vinogradov (Inst. Spectroscopy - Moscow)

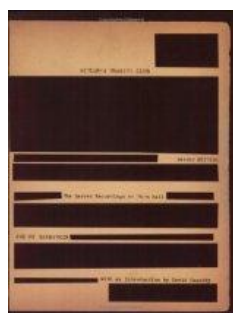


### **Physics of Semiconductor Microcavities - from Fundamentals to Nanoscale devices** **B. Deveaud - Wiley**

*This book is the collection of several modern review articles in new direction of physics of polariton excitations in microcavities. Last 5-7 years there is a boom in investigation of exciton-polaritons in special multilayered thin film structures with quantum wells based on different semiconductors.*

*There are several very interesting fundamental problems of electrodynamics in such structures and one of interesting idea is that excitons (electron-hole pairs) in such microcavities can condensate into Bose-Einstein condensation phase and in this case it will be very good new laser and/or very sensitive detector of light and for other applications of smart thin film structures.*

General reading - recommended by Dr. F. Mirabella (ArcelorMittal - Liege)



### **Hitler's Uranium Club: The Secret Recordings at Farm Hall** **Jeremy Bernstein - American Institute of Physics**

*During the Second World War some of the most important German scientists of the time were kept as prisoner by the Allies in Farm Hall, a British residency. What the German scientist ignored was that the house was equipped of microphone and that all their discussions were recorded.*

*Discover in this book some of the words exchanged between Werner Heisenberg, Otto Hahn, Carl Friedrich von Weizsacker... and make your own opinion about their possible contribution to a German atomic bomb.*

## Agenda

### **EXCELL - VINF**

- Training Course on Microstructure Charaterization of Nanostructured Films/Coatings, November 2-9, 2007 - Haifa (Israel)
- EXCELL Global Meeting, November 5-6, 2007 - Haifa (Israel)
- International conference on functional coatings, March 30 - April 2, 2008 - Budapest (Hungary) - <http://www.chemres.hu/nanocoatings/>

### **OTHER**

- 1<sup>st</sup> International Exhibition & Conference for the Vacuum and Coating Industries, October 3-6, 2007 - Milano (Italy) - <http://www.vacuumtech.eu/>
- Innovation on Thin Films Processing and Characterisation - November 20-23, 2007 - Nancy (France) - <http://www.vide.org/itfpc07.html>
- 9th International Conference on the Science of Hard Materials - March 10-14, 2008 - Montego Bay (Jamaica) - <http://www.icshm9.org/>

