Experiment Title: Determination of elemental composition for matrix nanocomposites polymers/metal nanoparticles, InN and nanostructured carbon materials using PIXE

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Short presentation of the scientific project

Applications

a) Research on polymeric nanofibers known important progress lately, beeing higly used in biomedical and biotechnological applications. These include medical implants, dental applications, biosensors, conservation of biological agents which are used for wound's patches, etc.

Figure 1). Biomedical and biotechnological applications of polymeric nanofibers

Silver nanoparticles have effective antimicrobial properties compared with other metals due to the extremely large surface to produce a better contact with micro-organisms. Silver is known as one of noble metals with the highest biocompatibility. Nanoparticles are tied to cell membranes and also penetrate inside the bacteria.

b) Until now the particular electronic state and transport effects were studied in semi-metallic and metallic structures, for which all lengths are typically isotropic sizes. In semiconductors (semiconductors with narrow forbidden band type AIV-BVI, Si, Ge n-type or Inn, ZnO) we can usually find anisotropic lengths. Study of the quantum dots structures (QD) from such materials offer the possibility to notice effects related to optical emission in low dimensionality structures. A quantum dot is a semiconductor whose excitons are confined in all three spatial dimensions. As a result, they have properties that are between those of bulk semiconductors and those of discrete molecules. Quantum dots are particularly significant for optical applications due to their theoretically high quantum yield. In electronic applications they have been proven to operate like a single-electron transistor and show the Coulomb blockade effect. Quantum dots have also been suggested as implementations of qubits for quantum information processing. The ability to tune the size of quantum dots is advantageous for many applications. For instance, larger quantum dots have a greater spectrum-shift towards red compared to smaller dots, and exhibit less pronounced quantum properties. Conversely, the smaller particles allow one to take advantage of more subtle quantum effects.

c) Applicative potential of carbon nanowall (CNW) is correlated with structure, the dimensional asymmetry (thickness reported in area), sharp edges and the extended surface in relation to the volume occupied. In agreement with these properties, research on the applicability with focus on field emission, electrical resistivity anisotropy, gas storage capacity and catalytic nanoparticles. Possible applications are electronic devices, new display devices and light sources with low consumption, membranes for fuel cells, catalysts for chemistry or un-pollution support.

Elemental analysis

The impurities in certain materials has a great importance in terms of their properties, improving or often resulting in loss of desired properties for the material in question. Thus more precise knowledge of their presence in samples to be analyzed has a great importance.

At this stage we intend to carry out elemental analysis using PIXE. Experimental setup to be used is sketched in Figure 3.

Figure 3 The scheme used for PIXE measurements

We estimate for each sample a acqusition time of about 2 hours, taking in consideration that we don't have a multi-target PIXE chamber at least 20 minutes are wasted for each sample. We have to analyze 30 samples which goes to a total time of about 3 days. In order to fulfil our experiment we intend to use extension 5 of the TANDEM accelerator in collaboration with dr. C. Ciortea. Beam characterstic: 3 MeV, protons, 10 nA.

Resulting data will be reported in the last stage of a National Partnership Grant. (PNCDI2 72-191, acronym NUCNANO) where IFIN-HH is the project coordinator. Deadline for the 3rd stage of NUCNANO project is December 2011, so we request if possible to schedule us somewhere between 01.10. and 15.11.2011.

The results will be also used in a PhD thesis of our collegue Ion Burducea.

As part of the romanian team involved in a COST action „Composites of Inorganic Nanotubes and Polymers" (COINAPO) (End date: May 2013) – MP0902 we will report the the results of this analysis using nuclear technique and the possible modification of the samples duet o beam interaction.

Beam time request(unit=8 hours) : 15

Desired Period : 01.10-15.11.2011

Desired beam properties

Type : p

Energy(MeV) : 3

Intensity(p/nA) : ~10 nA

Vacuum Requests : ~10^(-6) Torr

Special requirements for detectors, electronics,aquisition system

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Detectors for PIXE, spectroscopic amplificator

Minimal information needed for the radiological risk evaluation:

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a)Source activity : -

b)Use of open sources :

c)Estimate of the residual activity as a result of iradiation : -

d)Means of storage/transportation for iradiated targets : -

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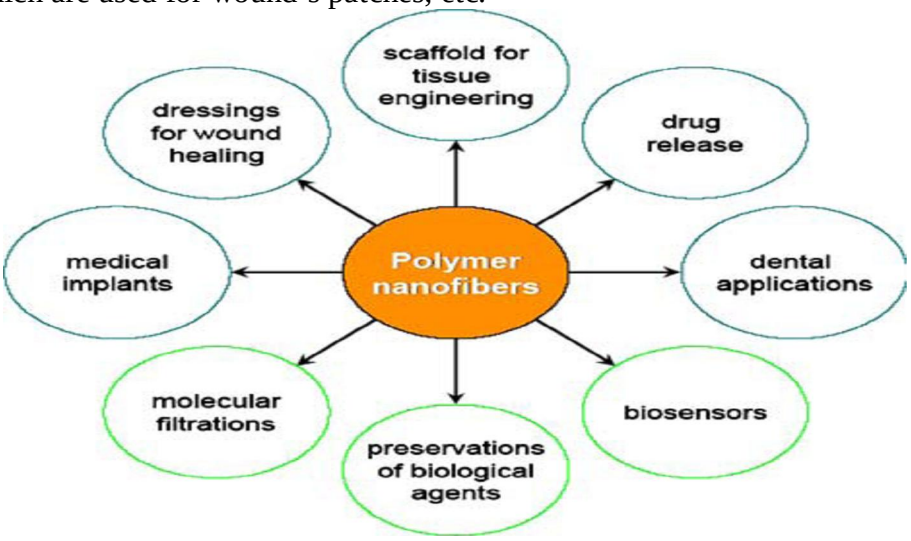

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d) Last, but not least we will analyze tungsten disulphide (WS2), which is actually the main reason for which we have rescheduled the final report of the National Partnership Grant (PNCDI2 72-191, acronym NUCNANO) for December 2011. This sudden change occured because of some intercomparative studies which will be made in the COST action „Composites of Inorganic Nanotubes and Polymers” (COINAPO) (End date: May 2013) – MP0902, where IFIN-HH is the Romanian coordinator.

WS2 is finding many applications where the stopping of pickup or seizing is important. WS2 is impinged upon the substrate at ambient temperature. It is applied to any metal without binders or chemical agents. It will not flake, chip or peel because it becomes part of the substrate. Used as coating it usually has 0.5 microns thick, maintaining the dimensional integrity of the substrate. It's inherent molecular shape and particle size prevent it from building thicker. The coating is blue-gray in color and resembles a rhodium finish. It will mirror back all the characteristics of the substrate. WS2 is inert, non-toxic, and non-corrosive. WS2 can be applied to all stable metal substrates. It is impervious to most solvents, refined fuels, and chlorinated solvents. It is attached by fluorine gasses, sulfuric and hydrofluoric acids and hot, caustic alkaline solutions. WS2 is resistant to corrosion but can not inhibit the effect of corrosion on inherently low resistance materials. WS2 is used successfully with petrochemical oils and greases, synthetic diesters oils, silicone lubricants and hydraulic fluids. It has an affinity for lubricants and strives to maintain a hydro dynamic layer.

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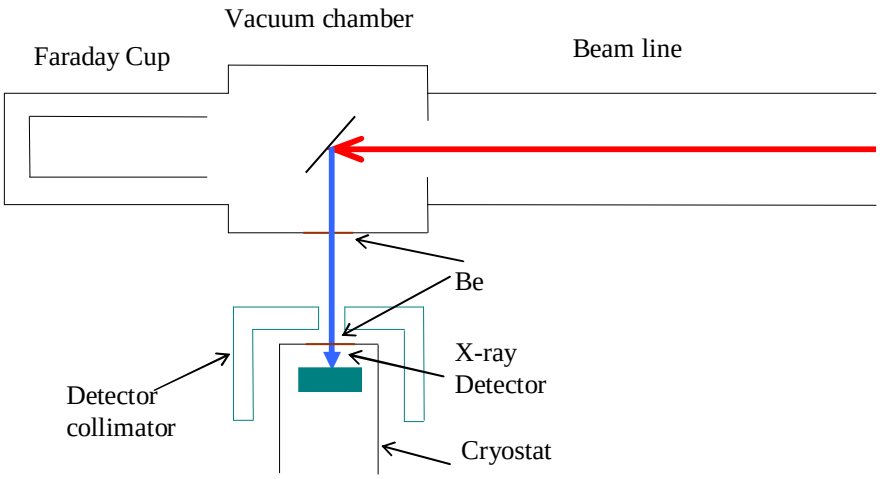

Figure 3 Exprimental setup for PIXE measurements schematics.

We estimate for each sample a acqusition time of about 3 hours, taking in consideration that we don't have a multi-target PIXE chamber at least 20 minutes are wasted for each sample. We have to analyze 50 samples which goes to a total time of about 5 days (15 shifts), if possible somewhere between 01.10. and 15.11.2011.

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