



Scientific Report

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Title: The study of polymer-laser radiation interactions in controlled atmosphere. Laser ablation nanostructured thin films layers. Applications

The developed activities to achieve the objectives for 2011 were:

1. Measurement concerning optical radiation action on the formation of nanostructures.
2. Analysis of polymer films surfaces with atomic force microscopy methods (AFM) and SEM.
3. Analysis of vibrational bands of the group - trans- and cis photoisomer - N = N- belonging to some polysiloxane deposited in the form of thin films.
4. Establish experimental methodology and literature review appropriate to polymers ablation and polymer thin film deposition.

The developing of nanotechnologies applied to nano-sensors and nano-composites are based on knowledges about the physical and chemical processes at nanometric scale. The modern materials are distinctive characterised by taking into account the quantic effects that mainly differ by initial structure. In this context was evidenced that a quota of organic polymer-based substrates offering a number of advantages over inorganic ones: are more flexible, offer a variable rigidity and can take different forms following the action of external factors. In addition, the polymeric material properties can be accustomed according to specific requirements by chemical modification or varying the polymerization conditions. Micro and nano-structures obtained using a polymeric support can be extremely useful to a variety of applications as well as conductors or circuit substrates obtained for adhesion control. Whatever the nature of their origin, the polymeric nanoparticles are found a stable structure, in contrast to other systems.

The nanostructuring phenomena intensely discussed in the international specialty literature, assess to obtain a capable material to generate a controllable surface structure. The current problems relate to the fact that a direct connection between chemical structure and nanostructuring mechanism of the used polymer does not exist. In this context, speciality literature talks about the developing a number of theoretical models and tools, based on two types of phenomena which try to explain the reordering processes of azo-materials surfaces.

The first involves a reorganisation of the polymer material and its compression under the UV radiation action and the second, assumes the displacement of the polymeric material (photo induced flow). Our studies are mainly focused on the chemical structure of the polymer and especially to influences over mechanism types and nanostructuring process. To

elucidate these issues, it have been studied in a first step, the expertise literature, regarding certain classes of polymers with different architectures, with based chain flexible and semi-flexible or rigid side and with lateral chain connected to different types of chromophores.

Among the processes that have drawn attention in this multidisciplinary field of nanotechnology, molecular and supramolecular ordering is considered of perspective, because at the molecular level, chromophores such as azobenzene groups are known for photo induced arrangement, after reversible reaction of trans-cis-trans isomerization.

In this case it results an almost perpendicular distribution of the transition dipole moments to the direction of action of the electric field intensity vector belonging to optical radiation linearly polarized.

Results

- There have been investigated polysiloxani type polymers, polymers having diazobenzen group perpendicular to the polymer chain.
- There have been obtained polymer thin films on quartz glass support and special glass transparent in the UV up to 260 nm, using spin coating deposition method.
- FT IR-ATR was studied for 80-120nm thick polymer layers.
- Studies have shown that vibration bands of trans- and cis photo isomers positions remain virtually unchanged under the action of electromagnetic radiation in the absorption domain of the diazo benzen group.
- We studied the effects of photochromic optical radiation in thin polymer layers and in solutions of dimethyl formamide.
- We mentioned the dynamic processes of trans- and cis photo isomers.
- Methodologies and experimental procedures are analyzed for strengthening the infrastructure of spectroscopy laboratory, in order to study plasma laser ablation of polymers azo-benzene and obtaining nanostructured polymer thin films.



Experimental set-up

Dissemination of results

1. Papers presented at the conference "Physics Conference TIM - 11", Timisoara, 24 to 27 November 2011

- R. Cimpoesu, O. Pompilian, N. Cimpoesu, D. Ghe. Dimitriu, S. Gurlui, and C. Focsa, UV-pulsed laser deposition of polymer thin films: fundamentals and applications, Physics Conference TIM – 11, 24 - 27 November 2011, Timisoara, Romania, (poster presentation);
- S. Gurlui, I. Lihtetchi, V. Hurduc, D. Ghe. Dimitriu, and M. Strat, Nanostructured polymer surfaces and nanoagregates of some diazobenzene polymers in film sate, Physics Conference TIM – 11, 24 - 27 November 2011, Timisoara, Romania, (poster presentation);

2. A paper is currently under review in an ISI journal

3. It was developed the basis of informatics and the corresponding site in order to present the current project, dissemination results of research and for the consolidation of project database: <http://spectroscopy.phys.uaic.ro/html/PROJECTS.html>

Project Manager,
Associate Professor Dr. Silviu Gurlui

