

**MULTIFUNCTIONAL POLYMER COMPOSITES:  
PRINCIPLES OF THE SYNTHESIS OF ELECTROMAGNETIC  
SHIELDING MATERIALS WITH LOW FLAMMABILITY**

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**ABSTRACT**

Novel PP-based electromagnetic wave shielding and absorbing materials with low combustibility enhanced thermal and mechanical properties, containing graphite, grinded wood and fire retardants, were developed and investigated. Their flame-resistance, thermal and mechanical properties are investigated. Electromagnetic wave reflection coefficients of the materials over the frequency range 20-40 GHz are measured; despite low concentration (10%) of functional filler, reflection coefficient can be as low as -11 dB. Coke formation mechanism is investigated, the principal role in this process is attributed to aromatisation and condensation of aromatic compounds with the formation of multiring aromatic systems, an important role of phosphoric acids in accelerating this process was found. Criteria of incombustibility of polymeric composites are formulated: thermochemical, kinetic, thermal, physical and mass transfer criteria. These criteria allowed to set up the principles of decreasing combustibility of polymeric composites. Thermodynamic scale of the relative reducing ability of chemical elements, which is required for the selection of optimum antioxidants, is suggested. Materials requirements, allowing to choose the most effective fireproof systems for multicomponent composites, containing polymers, wood and other fillers, were formulated.



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**NOVEL IN SITU SEQUENTIAL INTERPENETRATING POLYMER NETWORKS FROM OLIGOURETHANEMETHACRYLATE AND DICYANATE ESTER OF BISPHENOL A SYNTHESIZED BY COMBINED PHOTO/THERMAL CURING**

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**ABSTRACT**

A series of Interpenetrating Polymer Networks (IPNs) has been synthesized from oligourethanemethacrylate and cyanate ester of bisphenol A by a combined in situ sequential photo/thermo curing. The chemical structure of IPNs has been studied by FTIR spectroscopy, gel fraction content and density measurements. The phase structure has been studied by means of X-Ray diffraction, DSC and TMA, while the thermal stability has been estimated using Thermogravimetry technique. The interpenetration of the two network chains and possible chemical linking between the networks is discussed. The X-Ray, DSC and TMA data have shown that at low polycyanurate network (PCN) content, the structure of polyurethanemethacrylate (PUMA) network is semi-crystalline, while the compositions with PCN content greater than 25% and up to 50% are fully amorphous with a phase inversion process occurred. For IPNs with PCN content varying from 50% up to 95% a mixed phase is formed. The thermal stability of the IPN samples possessing mixed phase with greater content of PCN component is found to be higher.

**WATER DISPERSION OF POLYMER MATERIALS AND LATEXES  
PLASTICIZED BY EDOS**

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**ABSTRACT**

The effectiveness of EDOS as a plasticizer and noninogenic surfactant of water dispersions of polar polymers and latexes was established. The influence of EDOS composition on colloid-chemical properties and glass transition temperature of water dispersions and latexes was investigated. The formal of different alcohols as plasticizers of water dispersions and latexes were examined.

**EPOXY-RUBBER COATINGS WITH NANO-HETEROGENIC STRUCTURE**

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**ABSTRACT**

It has been found experimentally that formation of nano-heterogenic systems with fluorine containing surface active additives of optimal chemical composition is an effective method of obtaining of advanced coatings. The mechanical properties and chemical resistance of nano-coatings are significantly higher by use of surfactants with terminal carboxyl groups and less sterile volumetric molecules.

## **NANO-CELLULOSE AS PROMISING BIOCARRIER**

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### **ABSTRACT**

Main purpose of this paper is to describe the method for preparation of the reactive nano-cellulose biocarrier and to discuss some its biomedical and cosmetic applications. The method for preparation of the biocarrier was proposed that includes steps of controlled depolymerization of initial cellulose; structural and chemical modification in order to graft various biologically active groups substances to cellulose particles and high-power mechanical disintegration of the modified cellulose particles in liquid media. As a result, the dispersion of the bioactive nano-cellulose was obtained. Due to nano-size, particles of bioactive nano-cellulose capable clean skin's pores, open them and penetrate through the lipid layer and epidermis within the skin strata. This effect of the biocarrier can be employed at the development of advanced types of biomedical and cosmetics remedies used for gentle care and effective treatment of the skin.

**STRUCTURAL INVESTIGATIONS OF COTTON FIBERS  
OF VARIOUS TYPES**

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**ABSTRACT**

Macro- and fine structure, as well as chemical composition of fibers related to various sorts of cottons both white and naturally colored were investigated. The differences in structural parameters and chemical compositions of the cotton fibers were discovered. White long-length type of cotton fibers consist of long, thin and strong fibers with good ordered supermolecular structure. Fibers of middle-long white cottons have some lower ordered structural organization than long-length cotton. Fibers of naturally colored cottons are short, weak and characterized with disordered supermolecular structure. Conditions of cellulose isolation from the different cotton fibers, as well as structure and properties of the natural fibers, isolated cotton cellulose and prepared microcrystalline cellulose were discussed

## **MATHEMATICAL MODEL OF COMPILED CASCADE CLASSIFIERS**

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### **ABSTRACT**

Complex cascade classifiers are sometimes required in industry. They contain at least two parts, each of which is a regular cascade. They differ from regular cascade classifiers due to the fact that each part has its own separation coefficient. This paper considers all possible combinations of classifiers and determines the main calculation relationship among them.

**MEDIUM MOTION REGIMES AND UNIVERSAL CURVES OF  
GRAVITATIONAL SEPARATION PROCESSES**

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**ABSTRACT**

Similarity criteria [1] for obtaining universal separation curves in different regimes: laminar, transient and turbulent [6,7] were determined. However, the applicability limits for one or another criterion under specific conditions have remained unclear. In the present paper we analyze the physics of particles precipitation in different regimes and the flow influence on these particles. It is shown that the entire range from a laminar to a developed turbulent regime is covered by two similarity criteria.



**SUPER DEEP PENETRATION OF THE MICROPARTICLES ACCELERATED  
BY EXPLOSION IN METALS AND ALLOYS OF IRON**

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**ABSTRACT**

Features of penetration into copper barrier and in the barrier made of iron alloys are viewed. Two various models which at a qualitative level explain anomalies of penetration of clots of particles were used. At creation of "channel" elements initiation is viewed. For a steel barrier the density of initiation energy  $\rho_E=0,64 \times 10^9 \text{ J/m}^3$  is estimated. Regulation of superdeep penetration due to preliminary refrigeration strikers and barrier up to  $-196^\circ\text{C}$  is shown. Expenses of energy for superdeep penetration are reduced  $\approx 180$  times.

**NEW STRUCTURAL ELEMENTS ARISING IN ALUMINUM AND IT ALLOYS  
AT SUPERDEEP PENETRATION OF DOPE MATERIAL**

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**ABSTRACT**

Structural changes on macro-, micro - and nano levels typical for superdeep penetration (SDP) of dope dust like particles in aluminum and alloy Al-12% Si are detected. Affected zones in which the metal matrix is stitched by filaments from the dope material are determined. Chemical and electrochemical properties of these zones differ from properties of the initial material and are regulated by SDP action. New metal-composite materials can be created on this basis.

**POSSIBLE REASONS OF DEGRADATION  
OF ELEMENTS OF SPACE VEHICLE  
CONTROL-SYSTEMS**

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**ABSTRACT**

It was shown experimentally that super-deep penetration (SDP) effect occurs due to collision of a microparticles clot with a metallic thick-walled shell. It has been established that this process is accompanied by plasma microjets ejection from an internal surface of a protective shell. Plasma microjets are highly injurious in relation to elements (microcircuits) of electronic control systems.

**MARKETING ASPECTS OF THE POSSIBLE APPLICATIONS OF THE NANO-BASED DIAMOND-LIKE MONO CRYSTALLINE BORON CARBIDE (DLCBC) PRODUCT.**

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**ABSTRACT**

The possible applications of new advanced Diamond-Like Mono Crystalline Boron Carbide (DLCBC) as a winning competing product according to marketing researches, have vast market niches and DLCBC can be used in many fields of industry. There were considered only some new possible industrial applications of the new advanced DLCBC in such fields as: toolmaking industry, - such as precision grinding wheels and diamond saws, military industry for the production of bullet-proof vests / flacks and crashworthy armored pilot seats and also airliners and helicopter's turbojet engine blades, electronics industry for such applications as magnetron targets production for Thin Films / microchips and semiconductor substrates, intended for High Power High T<sup>0</sup>C chipsets, protection from neutron radiation and usage for jewelry. It is necessary also to note that above mentioned material DLCBC can be used for the traditional applications like nozzles etc., and can absolutely substitute the older industrial boron carbides in these applications. For the most promising practical applications there were performed marketing reports, showing that, even using designed laboratory pilot line, we can receive excellent results in the production industrial- ready and jewelry-ready DLCBC.

**INVESTIGATION OF PHYSICAL-MECHANICAL CHARACTERISTICS OF  
RUBBER-FABRIC MATERIALS BY ULTRASOUND METHOD**

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**ABSTRACT**

Technology, devices and gauges for deformation measurement of rubberized fabric materials by means of ultrasound are developed. The suggested method allows to run monitoring of the valid behavior of pneumatic structures during their operation.

**POWER TRANSMISSION LINE SAG MONITORING BY MEANS  
OF INCLINOMETERS.**

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**ABSTRACT**

This article investigates the problem of automated power transmission line sag monitoring. A novel method of sag monitoring system, based on 2 inclinometers installed at the conductor suspension points is presented. The solution is given for two separate installation options – when suspension points are located at the same elevation and when suspension points are located at different elevations. For each case sag evaluation formula is derived and its sensitivity is estimated. An exact solution based on the catenary equation and an approximate solution based on parabolic approximation are provided.

**THE POSSIBILITY OF REVEALING AND ASSESSMENT AGE RELATED  
DEGRADATION AND INDUSTRIAL FLAWS IN HIGH CHROMIUM STEELS  
PIPING AND EQUIPMENT  
BY QUANTITATIVE ACOUSTIC EMISSION  
NON-DESTRUCTIVE METHOD**

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**ABSTRACT**

The advantages of high chromium steels have been considered, which allowed increase the operating temperature of plants by about 60<sup>0</sup>C in 30 years, manufacture thinner and less heavy components, decrease time of start up and shut down processes, as well as thermal fatigue damage. At the same time it was revealed factors that decrease operation safety and lead to failures of high energy equipment and piping. The authors assumed that dangerous situations and economical losses could be prevented as a result of research and development concerning:

- The mechanisms of structural integrity transformation of new high chromium steels, their dependence from operational conditions, and external influences, the earliest quantitative indications of failures.
- Methods for evaluating danger level according to the fracture criterion of interacting randomly dispersed flaws.

It is demonstrated that the Quantitative AE NDI method that was successfully used to diagnose the condition of high-energy piping of nuclear and fossil power plants, chemical and refinery reactors, can be used after certain improvement to inspect high energy equipment made from high chromium steels.

**ADVANCED MATERIAL NANOTECHNOLOGY IN ISRAEL**

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**ABSTRACT**

One of the most interesting and perspective directions in material engineering of the last years is development of technology of nanocomposite materials consisting from two or more phases with precise interphase border and nanostructured materials based on interpenetrated polymer network. Israel is one of leaders in nanotechnology, not only in fundamental academic researches but mainly in industrial researches and founding start-up companies. Some important results in the nanotechnology material engineering field in Israel are summarized in the paper.