MODERN TRENDS OF THE CREATION OF NEW MATERIALS AND DEVICES

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The original metodology of the creation of Advanced Materials and Devices is considered. The proposed approach of design of new materials and anisotropic substances, modeling of various processes are based on the regularities of the evolutionary development of natural organic compounds; numerous data obtained in the last decades in the study of liquid crystals and ordered fluids; on the use of the anisotropy of the molecules of polyfunctional compounds for the design of new molecular structures (molecular engineering), films, liquid crystals [1], micelles, membranes, etc. and for the creation of anisotropic ensembles of molecules and biological systems.

The results of our investigations have shown that the combination of anisotropic materials, electrochemical techniques, nanostructured films and surfaces opens new possibilities of the creation of next generation displays, sensors, batteries with improved parameters; that anisotropic properties and good ordering of molecules of biopolymers give the opportunity of the preparation of original high ordered composites with a very wide spectrum of practical application.

We summarize and show here how the advanced both nonchiral and chiral nematic, smectic and other anisotropic compounds, batteries, sensors, photonic devices, displays can be successfully developed using the self-organizing systems, nanostructured surfaces, the transformations of the available 3,6-disubstituted cyclohex-2-enones (I), 5-substituted cyclohexan-1,3-diones (II), 3,5-disubstitiuted 2-isoxazolines (III), 1,2-disubstitiuted cyclopropanoles (IV), substituted epoxyketones (V) and substituted cyclohex-2-enonyl 2-isoxazolines (VI) or other similar intermediates (Fig. 1).

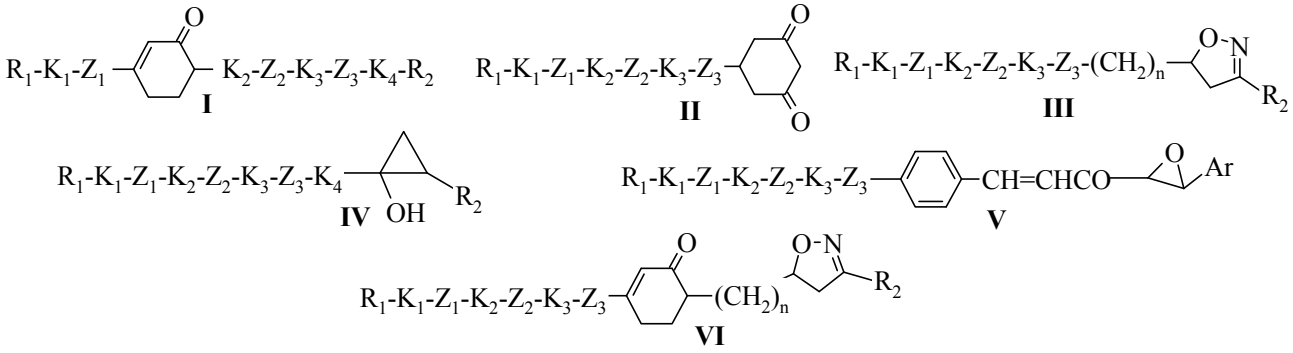

Fig. 1 – $R_{1,2}$ = alkyl or alkoxy fragments, F, Cl, CN, CF_3, OCF_3 or chiral fragment;
K_{1-4} = benzene or cyclohexane rings; n = 0-5;
Z_{1-3} = single bond or CH_2CH_2, or other bridge fragments

It have been shown that different reaction possibilities for the functional groups in the central core or at the terminal position, and cyclohexenone, cyclohexan-1,3-diones, isoxazoline, cyclopropanol or epoxyketone fragments; diversity of the variants of the modification of these intermediates under the influence of different chemical reagents and reaction conditions allow the transformations to be achieved selectively and give the opportunity of preparing mesomorphic and anisotropic compounds with novel combinations of the structural fragments of molecules.

It should be noted that the corresponding intermediates (I-VI) in addition to liquid crystalline and anisotropic compounds for display application may be also transformed under the influence of water, mineral acids, amines or other chemical reagents into corresponding anisotropic α-diols, or halogenehydrines, or amino alcohols, or water soluble salts, or metal complexes.

This allows in addition to prepare anisotropic surface modified polymers as the result of the bond formation between polymer activated centers and the functional groups of the unsaturated epoxy- and vinyl ketones.

The presented results also demonstrate that the combination of anisotropic materials, nanostructured films and surfaces, which are characterized by the ordered relief structure, opens the new approach of the creation of next generation of high quality displays with improved parameters.

Moving from individual LC molecules to anisotropic supermolecules, supramolecular chemistry and anisotropic ensembles, Science has come close to **anisotropic materials Science and self-organizing systems**.

We propose to use of anisotropy of molecules and the self-organized systems and processes:

– for the preparation of advanced materials (new classes of complex organic molecules, coordination compounds, composites, biochemical synthesis);

– for the development of batteries, sensors, photonic devices, displays;

– for the creation of devices based on anisotropic molecular ensembles (molecular electronics);

– for simulation and investigation of biological processes.

It is obvious that our proposed methodology is original and creative, has a number of distinctive advantages in comparison with the well-known methods of obtaining the analogous matters and structures, modeling of biological systems; and can be successfully used for the creation of next generation of materials and displays with a very wide spectrum of practical application.

References

[1] Bezborodov V.S., Mikhalyonok S.G., Kuz'menok N.M., Lapanik V.I., Sasnouski G.M. Polyfunctional intermediates for the preparation of liquidcrystalline and anisotropic materials. Liquid Crystals, Vol. 42, pp. 1124-1138 (2015).