A NEW DEVELOPMENT TREND IN MATERIALS SCIENCE

A.D. Verkhoturov, B.A. Voronov, V.M. Makienko(1), L.A. Konevtsov(2)
FederalStateBudgetInstitutionofScience, InstituteofWaterandEcologyProblems,
FarEasternBranch, RussianAcademyofSciences,
680000, Khabarovsk, Kim Yu Chen st., 65,ivep@ivep.as.khb.ru
(1) Federal State Budget Institution of Professional Academic Education,
Far Eastern State Railway University,
680021, Khabarovsk, Seryshev st.,43root@festu.khv.ru
(2) FederalStateBudgetInstitutionofScience, InstituteofMaterials Sciences,
FarEasternBranch, RussianAcademyofSciences,
680042, Khabarovsk, Tikhookeanskaya st.,153,root@infarest.khv.ru

The main paradigm of metallographical, physicometallurgical and materials science stages of the development of materials science (MS) was the focus on the interrelation 'composition - structure – properties'. However practical demands gradually shifted this focus to the problem of creating materials with target properties, which required a new paradigm. With this in mind, G.V. Samsonov, a prominent materials scientist, proposed the paradigm 'composition – structure – technology – properties', which gave a boost to materials science.

At the same time prominent achievements of structural-analytical and experimental materials sciences at the end of XX and the beginning of XXI centuries occurred together with increasing global problems, faced by modern sciences, including MS, such as catastrophic depletion of nonrenewable mineral resources, environmental problems caused by mining, processing and production of materials. In such a case 'the problem of a material' can be solved with a complex and consistent study of all the processes involved from the material 'birth' to its 'death'.

MS has already dealt with problems of complex and rational use of natural resources and in particular the task of producing new stating materials from wastes substances. Developed economies gave birth to a new materials science called 'integration materials science' (Germany). We proposed to call this new science 'materialogy', which together with traditional disciplines will include a new trend – entropic-ecological materials science (EEMS).

The goal of EEMS is to solve a triune task: to provide permanent supplies of raw products and materials, as well as to mitigate environmental losses. The scientific base for EEMS is the research of the cycle of substances and materials (CSM) in 'the second nature' at each of its stages.

It has been shown that studies of the initial stage of CSM (Lomonosov curve) are of primary importance for the resource producing regions as they help solving both the task of material production in the resource extracting regions and the triune task mentioned above.

The authors propose the criterion of entropic and ecological safety based on the assessment of energy deposition on substances and materials and changes of substance composition of elements and compounds in the environment after particular anthropogenic effects.

EEMSitselfiscomposedoftwoblocks. Thefirstoneiscreation, developmentandstudyofscientificguidelinesforman ufacturingstating products and materials from wastes. Thesecondismanufacturingmaterialsand finished products using mineral resources mined in the region without pyro-hydrometallurgy (mineralogical materials science).

The paper presents main provisions ofmineralogical materials science and basiccreation principles of titanium- zirconium- and tungsten-based materials, as well as boron mineral raw materials production with electroslag remelting process and aluminothermy. New instrumental and electrode materials which contain carbides and borides of high-melting metals, were created.