СЕКЦИЯ: МАТЕРИАЛОВЕДЕНИЕ И ПЕРСПЕКТИВНЫЕ ТЕХНОЛОГИИ

GENERAL PATTERNS OF THE USE OF PHYSICAL PHENOMENA AND TRANSFORMATIONS AT OPERATION INTELLIGENT MATERIALS

A. P. Cheiliakh, D.Sc (Eng.), Professor, SHEI «PSTU»,
Y. A. Cheylyakh, PhD (Eng.)

The regularities of the realization of physical phenomena and phase-structural transformations developing in the operation of many smart materials groups of various physical nature that provide the formation of their physical, mechanical and operational properties are generalized. A classification scheme of physicochemical phenomena is proposed, encompassing phase and structural transformations, atomic-nanostructural, electrical, magnetic, mechanical, optical, chemical and biochemical phenomena, on which the formation of the properties of a variety of smart materials in the process of operation is based.

The main signs of using these phenomena and transformations that determine the expected positive effect, manifested in the emergence or enhancement of individual properties or their complex, are formulated. The features of smart materials of various physical nature, the phenomena (transformations) realized in them in operation are considered. The most important advantages of metastable (smart) materials that self-organize during operation before phase-structurally stable for obtaining unique properties and their complexes are shown.

The models of the phase-structural evolution of traditional (stable) and smart (metastable) materials of self-organizing in the process of operation and life cycle are proposed. Based on the analysis and generalization, the general principles of designing smart (metastable) materials new generation with unique properties are formulated:

1. Metastability of the state of the material (product) and its ability to realize the nature phenomena (or transformation) inherent in its nature, which determine self-organization and self-adaptation in the process of operation.

2. Adjustability and programmability of the kinetics of the development of the phenomenon (transformation) at operation, when used by the composition and treatments.

3. Managing the evolution of the phase-structural state during the life cycle and, especially, under operating conditions, ensuring self-organization and improvement of the microstructure.

4. Formation of properties and operational resource due to controlled realization of the physical phenomenon (transformation).

5. A positive effect is the emergence of new or improved physical-mechanical and operational properties under the influence of a physical phenomenon (transformation) during operation.

6. Improvement of adaptive abilities to operating conditions due to the realization of the physical phenomenon (transformation), which determines the effect of self-improvement of the structure.

7. Optimization of the kinetics of the physical phenomenon (transformation) by harmonization with the kinetics of the action of the initiating factor of the operational environment.

8. Synergy of the complex of atomic-structural mechanisms for increasing individual properties or their complex due to optimal self-organization of the phase-structural state.

The obtained results can be recommended for the development of new types of intellectual materials and products, self-organizing and self-improving their properties in the process of operation.

СРАВНИТЕЛЬНЫЙ АНАЛИЗ КАЧЕСТВА ПРОИЗВОДСТВА И ПОКАЗАТЕЛЕЙ СВОЙСТВ ТЯЖЕЛОНАГРУЖЕННЫХ ЦЕМЕНТОВАННЫХ ШЕСТЕРЕН РАЗНЫХ ПРОИЗВОДИТЕЛЕЙ

А. П. Чейлях, проф., д-р техн. наук, С. А. Були, ООО «МАГМА»,
Н. Е. Мак-Мак, мастер производственного обучения, ГВУЗ «ПГТУ»,
М. И. Звонарева, ООО «МАГМА»

Обеспечение высокого качества тяжелонагруженных деталей машин, работающих зачастую, в экстремальных условиях, является весьма актуальной задачей современного машиностроения.

С целью проведения сравнительного анализа качества производства тяжелонагруженных шестерен редукторов породоразрушающих машин, были проведены исследования макро и микроструктуры зубьев шестерен разных производителей: фирмы Joy Global Inc. («Joy») (США), Ясиноватского машиностроительного завода («ЯМЗ») (г. Ясиноватая) и ООО «МАГМА» (г. Мариуполь). Содержание углерода на поверхности цементованных деталей «Joy» и «ЯМЗ» составляет 0,63 – 0,64 % и несколько выше – 0,82 % (местами до 0,97 %) у деталей производства «МАГМА». Глубина цементованного слоя несколько отличаются: 1,82 – 2,08 мм «ЯМЗ»; 2,1 мм «МАГМА» и несколько меньше – 1,56 мм «Joy». Шестерни производства «Joy» и «МАГМА» имеют зерно одинакового размера, соответствующее № 6-7, а производства «ЯМЗ» отличаются крупнозернистостью (№ 5-4). На поверхности зубьев производства «МАГМА» и фирмы «Joy» наблюдается