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Homogeneity measures in functionally graded materials

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The goal of the paper is numerical investigations of the influence of functionally graded materials (FGM) thermo-mechanical properties on the final internal stresses states in the coating. These layers are the modification of commonly used multilayer coatings deposited via Physical Vapor Deposition techniques (PVD), and can be highly effective in order to maximize the adhesion, hardness and thermal stability. Physical and mathematical models of the layers and substrate were created basing on classical theory of elasto-plastic materials. For the sake of mathematical modeling a transition functions, describing continuous physico-chemical material's parameters changes in each layer of K-layered coating were postulated. The transition layers were modeled using monotonic, nonlinear and asymmetric functions. For FGM assessment purposes measures of asymmetry and nonlinearity of the transitional functions were created. Using defined measures the degree of nonlinearity and asymmetry of postulated gradient layers was calculated. For practical purposes it was convenient to carry out investigations on specific representatives of the given transition function class. Then obtained results were expanded to remaining representatives (elements) of the class. Introduction of this measures is a step towards creating a universal sets of widely used metrics for functionally graded layers. This measures will enable the simultaneous assessment of influence of transitional function properties on the global character of gradient layer.

Research issues of FGM measurability are extremely important for the sake of the intelligent computer-aided design and optimization of PVD deposition processes software creation.

Biography

Lukasz Szparaga has recevied a Master Degree in Theoretical Physic in University of Gdańsk in 2007. Currently he is an assistant in the Department of Physics in Technical University of Koszalin. His research and scientific interests are related to mathematical physics, theory of systems and mathematical modeling and optimization of continuous processes. He has published 12 papers from the area of mathematical modeling and numerical simulations of protective multilayered coatings deposited via PVD techniques.

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Hydrotalcite supported Ni catalyst for the transesterification of glycerol with dimethyl carbonate to synthesize glycerol carbonate

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A large quantity of glycerol that is by-produced from biodiesel industry will lead to create a surplus in global glycerol market and jeopardize the oleochemicals market. The search for new destinations for this glycerol is the future promising technology worldwide. In this work, a series of catalysts with variable Ni loading (1% to 8%) were synthesized by incorporating Ni species into the interlayer of the solid base, hydrotalcite (HT) framework. The catalytic performance of the prepared catalysts was probed when employed to catalyze the transesterification of glycerol with dimethyl carbonate (DMC). Conventional metal oxides were also employed as supports for comparison purposes. It was observed that Ni-HT(3) with 2.5% Ni loading presented highly efficient approach in the selective synthesis of cyclic 1, 2-glycerol carbonate (GC) via reaction of glycerol with DMC. It possessed unique catalytic activity when catalyzed the conversion of more than 92% of glycerol toward the desired GC product under mild reaction conditions. It was found the reaction profile influenced by two groups of parameters; the catalyst formulation technique and reaction conditions. The prepared catalyst presented good catalytic stability when reused in up to four consecutive batch runs.

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