Carbon nanotubes (CNTs) are widely used as material reinforcement in the most diversified fields of engineering. Being their contribution significant to the mean properties of the materials thus reinforced, it is very important to assess the influence of CNTs properties' variability on the response of the resulting materials. For this purpose, in this work one considers functionally graded plates (FGPs) constituted by an aluminium continuous phase reinforced with CNTs. The CNTs' volume fraction evolution through the thickness is responsible for the plates' functional gradient. Since the present work aims to evaluate the influence of geometric and material CNTs properties on the static and free vibration response of FGPs, a data sample of those types of inputs, was randomly generated. With the results obtained, namely concerning neutral surface shift, shear correction factor, maximum transversal deflection and free vibration frequencies, multiple linear regressions were performed to assess the influence of the different inputs considered for this purpose. From the preliminary analysis of the multiple linear regressions results, the influence of the CNTs' outer diameter on the response of the plates stands out against the remaining inputs, both in terms of static and free vibration behaviour. However, for all the considered outputs, the models with the inputs CNTs' outer diameter, length and Young's modulus present the best fit. Also, all the inputs are statistically significant. The fact that the quality and the significance of the fit improves with increasing power law exponents is also noteworthy.

---

abst. 1027
"La Dolce Vita"
Wednesday
August 31
14h30

Numerical model of impact and fragmentation of interpenetrated composite

Postek, E. (epostek@ippt.pan.pl), Institute of Fundamantal Technological Research of the Polish Academy of Sciences, Poland
Pietras D. (pietras140t@gmail.com), Lublin University of Technology, Poland
Guhathakurta J. (guhathakurta@ct-lab-stuttgart.de), University of Stuttgart, Germany
Sadowski T. (t.sadowski@pollub.pl), Lublin University of Technology, Poland

The interpenetrating composites consist of a scaffold and metallic matrix, which fills it being introduced under pressure. The scaffold is usually crushable. In our case, the SiC material stands for the skeleton, while the AlSi12 alloy is the matrix. Both materials are crushable. The SiC phase is brittle throughout the loading process, but the AlSi12 alloy is brittle during the elastic phase; then, its behaviour becomes viscous-plastic. The presentation concerns the simulations of impact and fragmentation of metal matrix composite - AlSi12/SiC. The numerical model of the internal structure is created based on CT scanning. The microstructure of the composite is complex and consists of metallic phase (85%), ceramic SiC skeleton, porosity, and system of not perfect interfaces. The impacts are realized in the following few scenarios. The exemplary scenario is realized by imposing the initial conditions on the sample that hits a hard elastic barrier. The second one corresponds to SHPB experiments. The last one is the hitting of an elastic impactor against the sample. The influence of the impact velocities and material parameters of the phases on the failure modes is observed. Previously, analyses of the modes of loading application on the micromechanical failure of metal matrix composite were analysed in [1, 2]. An analysis of the empty SiC scaffolds is presented in [3]. The proposed finite element model of the AlSi12/SiC composite behavior describing gradual degradation under impact loading was tested for different scenarios of hitting. In all cases, the growth of damage in the composite is very realistic. These results lead to the conclusion the proposed finite element model is very effective. Acknowledgment: The results presented in this paper were obtained within the framework of research grant No. 2019/33/B/ST8/01263 financed by the National Science Centre, Poland. The numerical analyses were done in the ICM UW in Warsaw, CYFRONET AGH in Krakow and in CI TASK in Gdańsk, Poland. References: [1] Postek, E. and Sadowski, T. Distributed microcracking process of WC/Co cermet under dynamic impulse compressive loading. Compos. Struct. (2018) 194: 494-508. [2] Postek, E. and Sadowski, T. Qualitative comparison of dynamic compressive pressure load and impact of WC/Co composite. Int. J. Refract. Hard. Met. (2018) 77: 68-81. [3] Postek, E., Sadowski, T. and Bieniaś, J. Simulation of impact and fragmentation of SiC skeleton, Phys. Letters (2021) 24:578-587.
