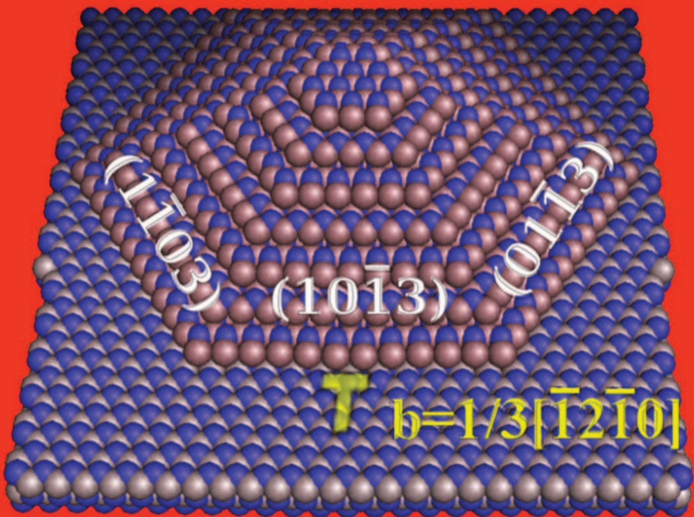
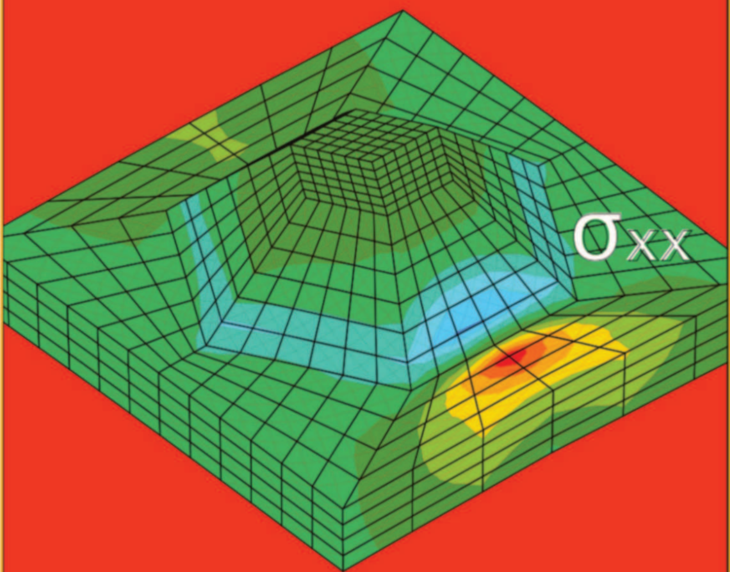
Paweł Dłużewski,
Grzegorz Jurczak,
Toby D. Young
(editors)



Book of abstracts

3rd International Conference on Material Modelling
incorporating the
13th European Mechanics of Materials Conference



September 8th - 11th, 2013
Warsaw, Poland

Instytut Podstawowych Problemów Techniki
Polska Akademia Nauk

Paweł Dłużewski, Grzegorz Jurczak, Toby D. Young (editors)

Book of Abstracts

Third International Conference on Material Modelling

incorporating the

Thirteenth European Mechanics of Materials Conference

September 8–11, 2013

Warsaw, Poland

Book of Abstracts
Third International Conference on Material Modelling
incorporating the
Thirteenth European Mechanics of Materials Conference

September 8–11, 2013
Warsaw, Poland

ul. Pawińskiego 5b, 02-106 Warszawa, Polska 2013

ISBN 978-83-83687-83-8

Numerical modeling of stresses in composites manufactured by powder metallurgy

Szymon Nosewicz[1], Jerzy Rojek[1], Katarzyna Pietrzak[1,2] and Marcin Chmielewski[2]

[1] Institute of Fundamental Technological Research Polish Academy of Sciences, Warsaw, Poland

[2] Institute of Electronic Materials Technology, Warsaw, Poland

e-mail: snosew@ippt.gov.pl

Powder metallurgy technology is one of the main method of manufacture process of advanced composite materials. During the sintering process, which is the most important stage of the powder metallurgy, loose powder is converted into a solid material due to temperature (close to the melting point) and pressure (additional). In the case of sintered composite with minimal porosity in the cohesive bonds of powder grains occur concentration of residual microstresses, mainly induced by the difference in thermal expansion of the two interacting phases during the cooling stage. The complex state of tensile and compressive stresses leads to the formation of microcracks and the progressive degradation of the material.

One of the efficient and appropriate tool to determine the powder metallurgy stress of composite material is numerical modeling. The manufacture process of composite material can be efficiently modeled by the discrete element method, which is a natural approach of modeling of particulate and granular systems. Discrete element method allows to model the interactions of powder particles in places subject to the highest stresses concentration.

This paper presents numerical modeling of two-phase material stress during and after the powder metallurgy process. The original thermo-viscoelastic model of discrete elements have been performed to model the sintering and cooling stages presented in [1]. Numerical simulations were carried out on the example of the NiAl-Al_2O_3 composite. As part of this study microscopic stress generated both in cohesive connection between the powder particles and in the same particles was determined. The knowledge of the microscopic material parameters, such as the residual stress or the radius of particle contact area, provided the data of macroscopic stress by application of averaging methods based on the concept of the representative volume element (RVE). The obtained results confirmed correct and efficient performance of the proposed numerical model.

Acknowledgments “The results presented in this paper have been obtained within the project funded from National Science Centre awarded by decision number DEC-2012/05/N/ST8/03376 and the project “KomCerMet” (contract no. POIG.01.03.01-14-013/08-00 with the Polish Ministry of Science and Higher Education) in the framework of the Operational Programme Innovative Economy 2007-2013”.

References

[1] S. Nosewicz, J. Rojek, K. Pietrzak and M. Chmielewski. Viscoelastic discrete element model of powder sintering Powder Technology, 2013 (In press).