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Impact model of two-phase composites

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Abstract:

Assessment of impact techniques is given in [1]. A basic model of a two-phase material is presented in [2]. Two-phase composites are of vital applications in modern technology, for example cutting tools, implants, jet engines. Examples of such materials are WC/Co and Al2O3/ZrO2. Highly innovative technologies need applications of modern polycrystalline materials. The manufactured polycrystalline materials are planned to have controlled internal structure. However, even though the process is controlled the internal structure can be still complex due to engineering requirements. The novel multiphase materials possess different internal geometries, for example (i) with regular of disordered internal structures with introduced fibers, particles or nanoparticles (ii) with a functional gradation of mechanical or physical properties (iii) fabricated as regular of irregular layered materials structures.

The analyses of modern composites require efficient computational methods and codes. The new method that has been developed mostly in the last ten years is peridynamics [3,4]. The developments resulted in a highly parallelised code [5] that we use in our analysis.

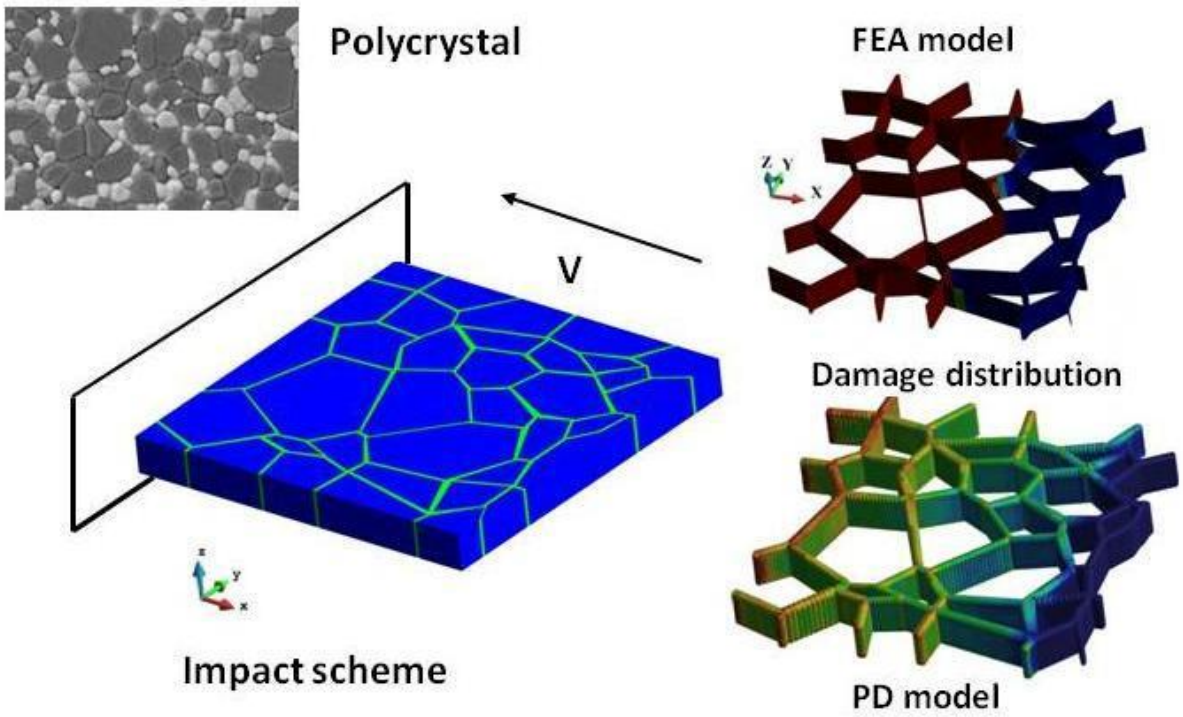

Fig. 1. A scheme of the analysis.

We further investigate the model of cermet that has been developed with the finite element method [6, 7, 8]. The primary goal of the paper is to investigate the previously formulated models of the two-

phase composite under impacts. We have taken into account the spatial distribution of cermet phases, grain/binder interfaces modelled by interface elements and movement of brittle grains.
We analyse a sample of the material that can be considered as Representative Volume Element RVE and do verification of the material properties of the RVE by multiplication of the elementary sample with complex geometry [9].
In Fig. 1, we illustrate an outline of the analysis. It is an Al2O3/ZrO2 polycrystal that hits a rigid obstacle with a velocity V. In this case, the velocity of the impactor is 100 m/s. We observe the damage development in the interfaces calculated with finite element and PD methods at time 10 ns. Further on, we consider damage models [10], elastic-plastic [11] and elastic-viscous-plastic models [12].

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