UNIVERSITÀ DEGLI STUDI DI BERGAMO
Dipartimento di Ingegneria e Scienze Applicate

Characterization and numerical modeling of nonlinear behavior in ceramic materials

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School of Engineering, Dalmine (BG) - Room B002
Microsoft Teams link https://bit.ly/3HVBquc

The most common assumption when modeling mechanical response of a ceramic material is that the material exhibits linear elastic behavior followed by formation of a crack with typically a rapid growth leading to material failure. While this is a reasonable assumption for relatively low temperature applications, there are number of situations in which a ceramic material evidences a nonlinear behavior with pronounced ductility, developing significant inelastic deformation. In such situations it is more appropriate to model the response within the framework of continuum damage mechanics, or even with classical plasticity theory. This approach may require employment of complex constitutive models with elevated number of parameters entering into governing equations. The quantification of these parameters, in general, is performed through mechanical characterization of a material which in these circumstances becomes fairly complicated. Significant practical advantages can be achieved if the characterization process is done on the basis of inverse analysis. This modern approach combines experiments with numerical simulations in order to build a discrepancy function, further minimized relying on mathematical programming algorithms. The scope of this lecture is to show some recent scientific advancements regarding the above outlined problems. Case studies that will be discussed are related to several different industrial fields. First two examples are dealing with modeling of porous ceramics, specifically modeling of thermally induced cracks and the change in an internal specific surface within macroscopically observed nonlinear regime of deformation. The modeling of the former is rather challenging as it has to deal with cracks with the ability to heal upon closing. The latter represents still an open question of explaining a contra intuitive result, confirmed within experiments, of diminution of a specific internal surface in damaged specimens. The other two examples are related to the simulation of a two-phase production of ceramic components: a powder cold compaction, as the first one, followed by a sintering at high temperature. It will be demonstrated how in both of these situations plasticity models can be used to predict quantities of practical interest.

Vladimir Buljak is full professor at the Department of Strength of Materials at Mechanical Engineering Faculty – the University of Belgrade. He is also a visiting professor at DICA Department at Politecnico di Milano since 2015 teaching a course of Theory of Plasticity at Master studies. He was the scientist in charge for several international and national projects dealing with material constitutive modeling and characterization. At the moment he is a project coordinator for the University of Belgrade within European project Horizon 2020-ITN-EDD RE-FRACTURE2 which deals with modeling and characterization of refractory materials.

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