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Perlite metal syntactic foam (PMSF) in impact engineering

Thomas Fiedler and **Mehdi Taherishargh**
University of Newcastle, Australia

Metallic foams exhibit a relatively constant deformation resistance during compression. As a result, they are highly attractive for impact engineering where controlled energy absorption and deceleration is required. Over the past decades, metallic foams have attracted growing interest due to their unique and multi-functional properties. However, to this date they have often failed to become a viable commercial solution. The key inhibitors are their high cost and the variability of mechanical properties. Perlite metal syntactic foam (PMSF, see Fig. 1) is a novel material that has the potential to overcome both limitations. It combines inexpensive raw materials (i.e., expanded perlite particles and standard casting alloys) with a close control of geometry and hence mechanical properties. In the presented study, PMSF is probed for its suitability as the energy absorbing element of an automotive crash cushion. In the first step, the desired material properties are derived from the permissible forces during the impact. In the following, the mechanical properties of PMSF are tailored to meet these requirements. This is achieved by increasing the perlite volume fraction and selecting pure aluminum as the metallic phase. To prevent the likelihood of global buckling a PMSF cylinder is selected as the energy-absorbing element. The component is tested both numerically and in a 2.5 tons drop test that replicates the forces occurring during an automotive impact.

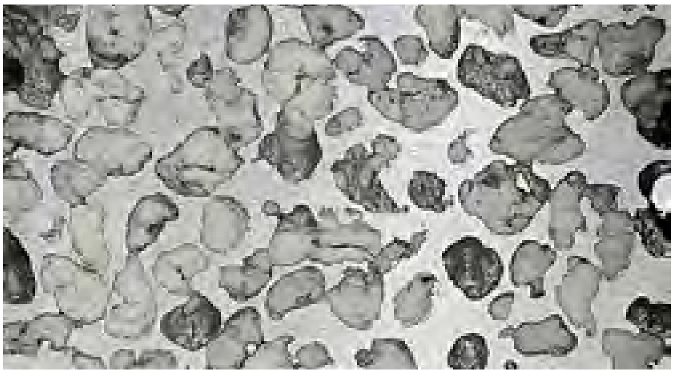

Figure 1: Cross section of PMSF.

Biography

Thomas Fiedler has completed his Master's degree in Mechanical Engineering from the University of Erlangen-Nuremberg (Germany) in 2004. He continued his academic career at the University of Aveiro (Portugal). After completing his PhD in 2007, he started working as a Post-doctorate at the University of Newcastle, where he is currently working as an Associate Professor. He has research expertise in cellular materials (metals and ceramics) and composite materials, experimental and computational mechanics, finite element methods, Monte Carlo methods, and mechanical and thermal material testing.

Thomas.Fiedler@Newcastle.edu.au

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