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Progress in Materials Science

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Wire-woven cellular metals: The present and future



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ARTICLE INFO

Article history:

Received 29 October 2014

Accepted 4 November 2014

Available online 27 November 2014

Keywords:

Wire

Cellular material

Weaving

Truss structure

Brazing

Helical forming

ABSTRACT

Wire-woven metals are a type of cellular metal composed of uniform 3D truss-like cells, and fabricated using wires as the raw material. Wire-woven metals are practically the most common choice for lattice truss metals to achieve multi-layered structures with fine cells. Since the new millennium, a number of wire-woven metals have been developed. This paper reviews various wire-woven metals and introduces their topologies and fabrication processes. In addition, their mechanical and thermal properties with analytic solutions, their variations, and applications are presented. Finally, the limits and prospects of wire-woven metals are discussed. The future of wire-woven metals seems promising due to the many options in the selection of the mother material, cell size, overall size, relative density, and cell geometry. Furthermore, their mechanical and thermo-hydraulic properties are superior to their competitors such as metal foams and they can be mass-produced at low cost.

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1. Introduction

'Cellular metal' is the most general term used to refer to a metallic body within which any type of gaseous void is dispersed [1]. Because of its lightness, unique mechanical and thermal properties, and potential for multi-functional applications, various cellular metals have been developed. Depending on the configuration of the cell structures, the cellular metals can be classified as shown in Fig. 1. Foams are cellular metals with stochastic structures composed of open or closed cells. The properties, productions and applications of foams have been comprehensively addressed in Ref. [2]. Their irregular topologies inevitably result in lower strength and stiffness at a given weight than those provided by their counterparts, periodic cellular metals (PCMs), that have regular topologies. As shown in Fig. 1, three types of PCMs are available: prismatic, shell, and truss. Prismatic PCMs have 2D structures with honeycomb and corrugated metals being typical examples. Shell PCMs are made by press-working of a single sheet of metal and have a 3D structure, with egg box [3,4] and folded core [5–7] as typical examples.

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