Macro and Nano Porous Materials

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Abstract

Porous metallic materials such as foamed metals, sponge-like metals, structural cellular metals, metals with directional pores and sintered metals are increasingly looked upon as potential light-weight structural and functional materials with, for example, superior sound absorption, damping and filtering properties. Not only porous metals but also porous ceramics, semiconducting materials and polymers are attracted much attention as unique functional materials in various fields, and some of them have been already implemented.

Keywords

Porous metallic materials; Foamed metals; Sponge-like metals

Recently new functional properties of bulk materials have been created by means of various techniques such as alloying, heat-treatment, plastic deformation and powder sintering. So far we have considered that the best way to produce high-performance functional materials is to decrease and/or eliminate any defects as much as possible. On the other hand, in a way different from conventional fabrication methods, porous materials effectively utilize pores and cavities by controlling their morphology in order to create new materials. Thus, porous materials initially aim not to densify the materials highly, but to densify lowly. In other words, new functional properties are derived by introducing many "null spaces" into materials intentionally.

The porous materials can be classified into two groups: macroporous and nanoporous materials. The former has the pores larger than micron meter in diameter, while the latter has the pores as small as nanometer. Besides, the materials also can be distinguished by the shape of pores, isotropic and anisotropic. Isotropic pores are spherical or polyhedral, while anisotropic pores are elongated pores aligned unidirectionally or distributed in random direction. Here, two kinds of examples on macroporous metals are shown in the next. Foamed metals can be fabricated by utilizing foaming phenomena; bubbling occurs when hydride is added into molten aluminum with high viscosity and during solidification process foaming takes place to produce foamed aluminum [1]. The porosity is more than 90%, which exhibits ultra-light-weight. Those are widely used to sound absorption, damping and filtering properties. Not only porous metals but also porous ceramics, semiconducting materials and polymers are attracted much attention as unique functional materials in various fields, and some of them have been already implemented.

Thus, porous materials show peculiar characteristics, which are much different from the conventional non-porous materials. Although there are some progresses in research on porous materials, science and technology of porous materials have not been established yet; there are a lot of unsolved problems to be investigated. Many scientists and engineers are welcomed to engage in research and development of porous metallic materials, semiconducting materials, ceramics and polymers.

References