Author's Accepted Manuscript

www.elsevier.com

A novel method for synthesizing ultralight silver foams by the silver mirror reaction

Bin Jiang, Qiuhong Zhao, Chunnian He, Chunsheng Shi, Naiqin Zhao

PII: S0167-577X(16)30346-9
DOI: http://dx.doi.org/10.1016/j.matlet.2016.03.024
Reference: MLBLUE20475

To appear in: *Materials Letters*

Received date: 22 September 2015
Revised date: 16 February 2016
Accepted date: 5 March 2016

Cite this article as: Bin Jiang, Qiuhong Zhao, Chunnian He, Chunsheng Shi an Naiqin Zhao, A novel method for synthesizing ultralight silver foams by the silve mirror reaction, *Materials Letters,* http://dx.doi.org/10.1016/j.matlet.2016.03.02

A novel method for synthesizing ultralight silver foams by the silver mirror reaction

Bin Jiang[a,b,c], Qiuhong Zhao[b], Chunnian He[a], Chunsheng Shi[a], Naiqin Zhao[a,c,*]

[a]School of Materials Science and Engineering and Tianjin Key Laboratory of Composites and Functional Materials, Tianjin University, Tianjin 300072, China

[b]Tianjin Special Equipment Inspection Institute, Tianjin 300192, China

[c]Collaborative Innovation Center of Chemical Science and Engineering, Tianjin 300072, China

[*]Corresponding author. E-mail: nqzhao@tju.edu.cn (N. Zhao)

Abstract

In this study, ultralight monolithic silver foams were synthesized by a novel and easy method based on the traditional silver mirror reaction. The resultant silver foams had remarkably low densities down to 18.7 mg/cm^3 or 99.8% porosity. The compression properties were measured and the present ultralight silver foams showed a similar stress–strain behavior compared with the other metallic foams. The densification strain of the silver foam can reach 80% because of the ultralow density. The compressive stress increased with increasing relative density.

Keywords: porous materials; microstructure; silver mirror reaction; ultralight; silver foam

1. Introduction

Ultralight cellular materials are desirable for thermal insulation, battery electrodes, catalyst supports, and shock energy damping. Until now, very few materials exist in the ultralight regime: carbon aerogels (density $\rho \geq 0.16$ mg/cm^3) [1], silica aerogels ($\rho \geq 1$ mg/cm^3) [2], carbon nanotube aerogels (ρ=5.8-25.5 mg/cm^3) [3], metallic foams ($\rho \geq 3.3$ mg/cm^3) [4,5], and polymer foams (ρ=8-10 mg/cm^3) [6]. To date, techniques for producing ultralight metal foams have been somewhat limited. Moreover, approaches to the synthesis of ultralight non-metallic foams are not well-suited for metals [1-3,6]. The ability to form ultralight monolithic metal foams is difficult and sometimes elusive with the use of conventional methodology [7].

There are several well-established approaches for preparing ultralight monolithic metal foams. B.C. Tappan reported a relatively simple method for obtaining ultralow-density, monolithic, transition-metal foams, utilizing self-propagating combustion synthesis of novel transition-metal complexes containing high nitrogen energetic ligands [4]. Ultralight magnetic Ni/C, Co/C, and Fe_2O_3/C foams were fabricated on the centimeter scale by pyrolyzing commercial polyurethane sponge [5]. Electroless plating on polymer templates have also been applied to produce porous structures. The coating should be as thin as possible in order to synthesize the metal foams with ultralow density. But the films are too weak to stand as a monolithic