POROUS METALS THROUGH POWDER PROCESSING: THE CHALLENGES AND POSSIBILITIES OF INTRAPARTICLE EXPANSION

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ABSTRACT

A solid-state foaming process known as Additive Expansion by the Reduction of Oxides (AERO) was further studied to determine if milling could be done at room temperature rather than under cryogenic conditions. A previously studied Cu-CuO composite was milled at room temperature with and without the use of a process control agent. It was determined that room temperature milling without a process control agent produced metal foams with porosity similar to those produced by cryogenically milled alloys. Therefore, the AERO process can be simplified to room temperature mechanical alloying for shorter periods of time.

INTRODUCTION

Nature is known for creating very efficient materials where needed. Porous materials in nature have very unique properties, such as absorption, low specific weight, high gas permeability, buoyancy, and good strength with low density. Artificial materials with these properties are highly desired in many different fields. Polymeric and ceramic foams have widespread applications; however, by using other materials, such as metals, low density materials can be extended to include metallic properties [1, 2]. Metal foams are highly-porous metals with a vast range of uses. Metal foams can be used as lightweight structural materials, catalysts, filters, and battery electrodes [3]. Liquid-state methods are commonly used to synthesize metal foams of materials such as aluminum due to its relatively low melting point and low reactivity. For some materials, such as titanium, liquid-state casting is not a viable method of forming metal foams due to high melting points, high affinity of the melt to atmosphere, and high reactivity to mold materials [4, 5]. To overcome the obstacles in liquid-state foaming, powder-metallurgy processes can be used to produce metallic foams. The existing solid-state methods can be classified into two groups: 1) powder sintering and 2) pressurized pore expansion. The porosity of the metal foams made using the