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Reduction of Pneumatic Pressure Loss in Nanoporous Media Using Vertically Aligned Nanochanels

Byeong Hee Tae[1], Woong Ki Jang[2], Byeong Hee Kim[1,2], Young Ho Seo[1,2*]
[1] Interdisciplinary Program in Biohealth-Machinery Convergence Engineering, Kangwon National University
1, Kangwondaehak-gil, Chuncheon-si, Gangwon-do, Republic of Korea
tae8680@kangwon.ac.kr (B,H,T) , kbh@kangwon.ac.kr (B,H,K), mems@kangwon.ac.kr (Y,H,S)
[2]The Advanced Education Center of Convergence Technology in Personalized Smart Healthcare System for Active Seniors, Kangwon National University
1, Kangwondaehak-gil, Chuncheon-si, Gangwon-do, Republic of Korea
wkddndrl@kangwon.ac.kr (W,K,J)

Extended Abstract

The sizes of elements and components used in the semiconductor and display industries are getting smaller. Precision is required in the manufacturing process and inspection process of these elements. In order to ensure precision, it is very important to fix elements and components during processing. In the current industry, small or thin elements that have limitations in physical fixing methods are fixed using electrostatic methods, bonding methods, and vacuum methods. The bonding method is a method of attaching directly, and it is difficult to use in ultra-fine processes due to problems such as surface contamination, and thus a vacuum method or an electrostatic method is mainly used. The electrostatic method generates a potential difference between the electrode surface and the attachment surface to fix the element with the force of coulomb.[1] The electrostatic method is free from adsorption traces or the size limitation of the element but has a disadvantage in that the element may be damaged by the electrostatic charge and can be used only for magnetic objects. The vacuum method uses an atmospheric pressure difference according to atmospheric pressure and reduced pressure. In the current industry, the size of the pores used in the vacuum method is limited in the micro-scale. Therefore, the size of the elements used is also limited according to the size of the diameter. Current vacuum methods are used by attaching ceramic plates for reasons such as improved precision and partial adsorption. Ceramic plates are manufactured through a sintering process using ceramic powder. Ceramic plates are manufactured through a sintering process using ceramic powder. To make nano-sized powders, there are methods such as combustion synthesis using hydrolysis and chemical synthesis using high-frequency plasma, but it is expensive and difficult to make powders of the same size.[2] In addition, when nano-level pores are made using the sintering process have a thickness of more than 5 mm, and a sponge-shaped micro-channel shape is produced, forming a longer air path than the vertical channel shape, increasing fluid resistance. As a result, a lot of air pressure loss occurs. Therefore, in this paper, a vertical channel-shaped porous medium with a nano-scale diameter with reduced air pressure loss compared to the conventional ceramic plate was proposed. Vertical nanochannels were fabricated using an aluminum anodization process. The fabricated vertical nanochannel has a pore diameter of 190~210nm and a thickness of 156um. As a result of the experiment, the conventional commercial ceramic plate showed a pressure reduction of about 40 to 80%. However, the vertical nanochannel porous medium proposed in this paper showed a pressure reduction of about 28%, showing a pressure reduction of 2 to 7 times that of the conventional ceramic plate. Through this, it was confirmed that the vertical nanochannel porous medium has improved performance compared to the ceramic plate manufactured based on the conventional sintering process.

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