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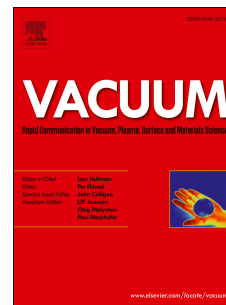
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Abstract: Small characteristic sizes ($< 1 \mu\text{m}$) for vacuum leak elements are essential to achieve low conductances and high operating pressures in the free molecular flow regime. In this study, a miniature vacuum leak element is fabricated using a porous nickel sheet with pore size of less than $1 \mu\text{m}$ and a vacuum coupling radius seal (VCR) type gasket. One side of the porous nickel sheet is well sealed for restricting conductance by the simple polishing and sintering method, and a hole with diameter of about $100 \mu\text{m}$ is drilled with a laser in the sealing film for conducting gas. In the molecular flow regime, the typical conductance of the leak element is $\sim 10^{-9} \text{m}^3/\text{s}$, and the operation pressure can be up to about $5.0 \times 10^4 \text{Pa}$ for Ar, and $1.0 \times 10^5 \text{Pa}$ for He. Other advantages are: (1) the 4-VCR type leak element is very small, and can be easily fabricated; (2) the proper sintering process significantly improve the strength of porous material, and the presented leak is very robust; (3) the sheet shape for porous nickel is conducive to releasing the adsorbed gas; (4) technically, the porous nickel and the VCR nickel gasket can be welded together. Thus, the all-metal type leak is feasible.

Keywords: Miniature; Vacuum leak; Porous nickel; All-metal

1. Introduction

The use of vacuum leak elements is to limit gas flows or provide accurate flow rates, and are widely applied in vacuum metrology [1,2], vacuum leak detection [3], and gas sampling and analysis [4,5]. Some vacuum leak elements are obtained by drilling a hole in 1 mm thick metal sheets (stainless steel, aluminum, copper) with lasers [6]. These bakeable leak elements are simple, robust, and quite applicable. However, it is very difficult to get a

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