AlN Microbridges for MEMS and NEMS Applications

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ABSTRACT

Extracting optimum performance from a fuel cell requires precise control of gas flow to multiple cells. Implementing conventional valve technology in these structures is not feasible due to increased costs and space considerations. As such the design and development of valves having dimensions very small compared to the conventional valves at low cost and the ability of such material systems to operate at high temperatures may well aid in achieving the optimum performance. Electronically controlled valves having dimensions in the range of micrometers can be easily fabricated through the already established MEMS technology. A micro bridge belongs to the category of electronic actuators that undergo deformation in response to an electrical signal thereby can change in the net volume enclosed by the bridge. Gas flow rate through these bridges can be precisely controlled through this mechanism.

AlN is the material of choice for fabricating these MEMS structures because of its chemical inertness and the ability to maintain its piezoelectric properties at high temperatures. In addition to this AlN can be electronically integrated with the established Si-MEMS technology. AlN channels were can be fabricated on Silicon using standard lithography process and MOCVD techniques.

Free standing AlN micro channels of varying air gaps from 130nm to 800nm and AlN film thicknesses of 130nm to 900nm were fabricated on Si (111). These micro channels can be actuated through the metal contacts, deposited on the surface of the micro channels through standard UV lithography process. The deformation produced in the AlN due to the applied electric field will affect the channel flow path of the gas and hence control the gas flow rate precisely.