

※課題番号 : N-12-NU-0009  
 ※支援課題名 (日本語) : シリコン MEMS の強度信頼性評価と疲労破壊機構の解明に関する研究  
 ※Program Title (in English) : Strength and Mechanical Reliability of Silicon MEMS  
 ※利用者名 (日本語) : 泉 隼人  
 ※Username (in English) : Hayato Izumi  
 ※所属名 (日本語) : 名古屋工業大学  
 ※Affiliation (in English) : Nagoya Institute of Technology

※概要 (Summary) : Fracture behaviors of single crystalline silicon (SCS) thin films were investigated under two environments, i.e; inert nitrogen gas and DI water, and compared with each other. Testing temperatures were set at 22°C and 70°C for nitrogen gas and 22°C for water environments. Static tensile fracture tests were performed with monotonically increasing load on 2 μm thick p-type SCS thin film specimens. The results show significant changes in the fracture stress level in higher temperature under nitrogen gas atmosphere although there was very small influence of water compare to nitrogen gas.

※実験 (Experimental) : A tensile test structure and thin film specimens made of CZ-grown SCS were fabricated by micromachining from SOI wafer. SOI wafer is consisted of silicon device layer of 2 μm, buried oxide layer of 0.8 μm, and silicon handle layer of 400 μm. Firstly, positive PR was spin coated on top of the both surfaces. After the wafer was soft baked, the PR was exposed and developed for patterning the specimen (PEM-800, Union Optical Co. Ltd.). Afterward, DRIE process was applied initially from the device layer surface up to the buried oxide layer and consequently from handle layer surface to form the gap under the specimens. Finally, buried oxide layer were removed by using HF solution, respectively.

※結果と考察 (Results and Discussion) : The result of static fracture test in different environmental conditions was shown in Fig. 1. The symbols and curves mean the experimental data and best-fit Weibull distribution, respectively. It is clearly observed that the change in environmental

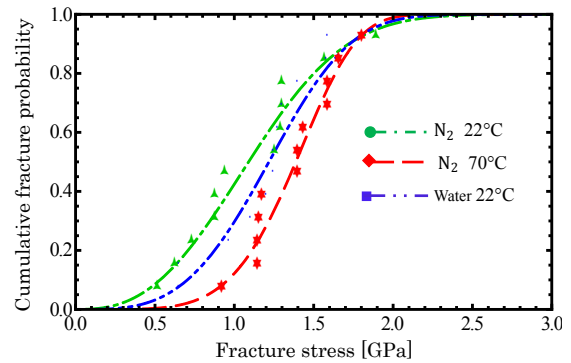


Figure 1: The results of static fracture test in different environmental conditions.

conditions from inert nitrogen gas at 22°C to higher temperature at 70°C causes increase in the average static strength by approximately 24%. The curve for water slightly changed to higher strength level compare with nitrogen at 22°C. Judging from test of significance, the influence of temperature in nitrogen gas has more significant difference in fracture stress level and water has no significant changes in fracture stress compared to nitrogen gas at 22°C.

※その他・特記事項 (Others) :

none

論文・学会発表 (Publication/Presentation) : Effect of Water and Temperature on Mechanical Fracture Behavior of Single Crystal Silicon, Proc. JSME 2012 Conference, Kanazawa, Sep.9-12, J032013 (2012).