Wednesday Morning Poster Sessions, October 4, 2000

MEMS
Room Exhibit Hall C & D - Session MM-WeP
Poster Session

MM-WeP1 Characterizing the Thermal Behavior of Thin Films Using Micromachined Cantilevers*, **H.-C. Tsai**, W. Fang,* National Tsing Hua University, Taiwan

The thermal stress is a very important factor of fracture for microstructure. In this paper, we exploit the micromachined cantilever to investigate the thermal behavior of the thin films. The thermal behaviors of thin films were characterized under two thermal loads including the thermal cycle load and the isothermal load. Thus, the variation of the thermal stress of thin film with the thermal loading time is studied. Moreover, the variation of the thermal strain rate of thin film with the film thickness is also discussed. In summary, the strain rate of thin film is proportion to the film thickness after the isothermal load test. On the contrary, the strain rate of thin film is in inverse proportion to the film thickness after the thermal cycle load test. In this study, the silicon dioxide cantilevers were fabricated through the bulk micromachining. The film to be characterized was then deposited on top of the cantilever to form a bi-layer beam. Since the thermal expansion coefficient (CTE) of the film and that of the silicon dioxide are different, the film will subject to stress during the thermal load test. The strain of the deposited film is determined by the deflection of the bi-layer beam. For the isothermal load test, the bilayer beam was heated by a heating stage. As to the thermal cycling load test, the sample was placed into a chamber that can set the variation of the temperature with time. In application, the thermal behavior of the sputtered Al film is studied. The Al film is under compression during heating since its CTE is larger than that of the silicon dioxide. As a result of isothermal load, the total compressive strain of the Al film was increased drastically in the beginning. However, the compressive strain of the Al film was gradually decreased after a certain heating time. It was obtained that the decreasing rate of the strain was proportional to the film thickness. For the thermal cycle load test, the variation of the strain of Al film with the number of thermal cycle was measured. We obtained that the compressive strain of Al film was drastically increased for the first 200 cycles, and then gradually decreased. According to this study, the thermal behaviors of thin films under the static and the dynamic loads are discussed. In addition, the film thickness will be an important factor for the thermal behaviors of thin film.

MM-WeP2 Electrical and Spectroscopic Characterization of Palladium Implanted Elevated Temperature Silicon Carbide Chemical Sensors*, **C.I. Muntele**,* Alabama A&M University*; P. McCarty,* University of Alabama, Huntsville*; I. Muntele, D. Ila,* Alabama A&M University*; J.J. Weimer, M.A. George,* University of Alabama, Huntsville*; D.J. Larkin,* NASA Glenn Research Center*; D.B. Poker, D.K. Hensley,* Oak Ridge National Laboratory

Silicon carbide is a promising material for creating microelectromechanical devices and integrated chemical sensors capable of working at room temperature as well as at high temperatures, and in harsh environments. This team has developed a unique miniaturized SiC chemical sensor that operates from room temperature to above the temperatures (300-500oC) of previously reported semiconductor based chemical sensors. To produce these sensors, we have implanted Pd ions at energies between 100 keV to a few MeV into the Si face of 6H-SiC at both room temperature and at 5000C. The peak concentration of implanted Pd was kept between .01% to 10% of the host. The electrical properties of fabricated sensors were measured at room temperature up to 500oC. We will discuss both the preparation and characterization of these sensors. In order to understand the sensing mechanism of specifically implanted samples, the change in the chemical structure of SiC at the surface and near the implant layers were analyzed using ESCA, micro Ramman, UV absorption spectroscopy and Raman techniques both before and immediately after exposure to hydrogen and Methane. The location of the implanted species was simulated using TRIM code as well as using RBS techniques. We will report the correlation of this simulation to the experimental results obtained from measurements of electrical properties, optical properties and surface analysis Research sponsored by the NASA Grant No. NG3-2302, and partially by the Center for Irradiation of Materials of Alabama A&M University and the Division of Materials Sciences, U.S. Dept. of Energy, under contract DE-AC05-96OR22464 with Lockheed Martin Energy Research Corp.

MM-WeP3 Polymer Based Microsensors Using Piezoresistive Microcantilever Technology*, **T.L. Porter**, M.P. Eastman, D. Pace, M. Bradley,* Northern Arizona University

We have tested a new type of microsensor based on piezoresistive microcantilever technology. In these devices, tiny beads of polymeric or functionalized polymeric material deposited on a substrate are in direct contact with the microcantilevers. Upon exposure to analytes, the polymers may expand or contract, and this volume change is measured directly by the piezoresistive cantilever. The measured response is a simple change in the resistance of the cantilever. There are many advantages of this type of sensor over microsensors based on chemiresistor or vibrating cantilever methods. Many individual sensing units may be incorporated into a "single chip" array using existing semiconductor fabrication techniques. Control and sensing electronics are very simple and inexpensive, making portable sensing arrays practical. There is no need to coat, functionalize, or attach species to the cantilever. Using biologically active layers in place of the polymeric materials, bio-sensor arrays may also be produced. In this paper, the piezoresistive cantilever technology is tested using plymers such as PEVA in the prsence of analytes such as toluene, hexane, water vapor, ethanol and acetone.

Author Index

Bold page numbers indicate presenter