Materials Science & Engineering Master's Defense

Response of Metal Structures on Chalcogenide Thin Films to Thermal, Ultraviolet and Microwave Processing

School for Engineering of Matter, Transport and Energy

Benjamin Roos
Advisor: Terry Alford

abstract

Microwave (MW), thermal, and ultraviolet (UV) annealing were used to explore the response of Ag structures on a Ge-Se chalcogenide glass (ChG) thin film as flexible radiation sensors, and Te-Ti chalcogenide thin films as a material for diffusion barriers in microelectronics devices and processing of metallized Cu.

Flexible resistive radiation sensors consisting of Ag electrodes on a $Ge_{20}Se_{80}$ ChG thin film and polyethylene naphthalate substrate were exposed to UV radiation. The sensors were mounted on PVC tubes of varying radii to induce bending strains and annealed under ambient conditions up to 150 °C. Initial sensor resistance was measured to be $\sim 10^{12}$ Ω; after exposure to UV radiation, the resistance was $\sim 10^{3}$ Ω. Bending strain and low-temperature annealing had no significant effect on the resistance of the sensors.

Samples of Cu on Te-Ti thin films were annealed in vacuum for up to 30 minutes and were stable up to 500 °C as revealed using Rutherford backscattering spectrometry (RBS) and four-point-probe analysis. X-ray diffractometry (XRD) indicates Cu grain growth up to 500 °C and phase instability of the Te-Ti barrier at 600 °C.

MW processing was performed in a 2.45-GHz microwave cavity on Cu/Te-Ti films for up to 30 seconds to induce oxide growth. Using a calibrated pyrometer above the sample, the temperature of the MW process was measured to be below a maximum of 186 °C. Four-point-probe analysis shows an increase in resistance with an increase in MW time. XRD indicates growth of CuO on the sample surface. RBS suggests oxidation throughout the Te-Ti film. Additional samples were exposed to 907 J/cm^2 UV radiation in order to ensure other possible electromagnetically induced mechanisms were not active. There were no changes observed using XRD, RBS or four point probing.

July 24, 2013; 12:00 PM; ECG 214