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Interface formation Cu/polyimide studied by x-ray photoelectron spectroscopy

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I. INTRODUCTION

In very large scale integrated(VLSI) and highly miniaturized electronic devices, the Cu/polyimide(PI) system is known to be the best candidate for a multilevel interconnection system since Cu is a low resistance metal and polyimide is a low dielectric material. Technical concern for the Cu/PI system lies in the enhancement of interface adhesion. The adhesion between two materials depends on the surface and near-surface chemical interactions and to inter-mixing across those boundaries. In the past few years, a number of studies have been reported using x-ray photoelectron spectroscopy(XPS) to investigate the chemical bonding on polymer surfaces and metal-polymer interfaces. However, the details of surface and interface bonding in Cu/PI system are still not adequately known.

In order to understand Cu/PI interface formation at room temperature, we studied the reaction of Cu in the context of different PI functional groups. Detailed information about the interface chemistry can be extracted from C 1s, N 1s, O 1s, Cu 2p core level line-shape, and Cu LMM Auger line-shape, and valence band spectrum.

II. EXPERIMENTAL

X-ray photoemission experiments were performed in a UHV system at a base pressure $\sim 1\times 10^{-10}$ Torr. The UHV chamber was equipped with a PHI model 5700 x-ray photoelectron spectrometer. Photoelectrons were excited by monochromatized

Al Kα(1486.6 eV) irradiation. The pass energy of PHI hemispherical electron energy analyser was 23.5 eV, giving an energy resolution of 0.7 eV to the Ag $3d_{5/2}$ line for high resolution studies of core and valence level. The electron beam shower method was employed to avoid the charging effect.

Cu *in situ* deposition was made by Ar^+ ion sputtered deposition onto commercially available PI(Kapton). The deposition rates for Cu were ~1 Å/min. as determined by RBS and the pressure of this system was maintained in the low 10^{-8} Torr range during the film deposition.

III. RESULTS AND DISCUSSION

The interfaces formed by deposited Cu layer on polyimde have been studied by XPS with the number of coverages of Cu.

We can see that Cu-O complex is formed in O 1s spectra. Especially, from Cu LMM Auger spectra, we can see that at first Cu-N-O complex is formed and sequentially Cu-O complex is formed.

Finally, we can conclude that Cu is relatively reactive with most of elements such as oxygen and nitrogen in PI.

REFERENCE

1. James M. Burkstrand J. Appl. Phys., **52**, 4795 (1981).
2. F.Iacona and M Garilli J. Mater Res., **6**, 861 (1991).
3. J.F.Moulder, W.F.Stickle, P.E.Sobol, K.D.Bomben *Handbook of X-ray Photoelectron Spectroscopy* edited by J.Chastain and R.C.King, Jr. (Physical Electronics, Inc., USA, 1995)

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