Investigation of Removal Efficiency of Surface Passivation on Pattern Effect of Cu Abrasive Free Polishing

Jeng –Yu Fang, Ming – Shih Tsai[a], Bau – Tong Dai,[a] and Ming – Shiann Feng

Institute of Materials Science and Engineering, National Chiao Tung University,

[a]National Nano Device Laboratories, Hsinchu 30050, Taiwan

1001 Ta Hsueh Road, Hsinchu, Taiwan 300, ROC

Abstract

Introducing conventional Cu CMP (chemical mechanical polishing), Cu planarization suffers non-uniform step height reduction between various features Cu lines, by mean of pattern effect. Based on the demonstration of pattern effect, additive pressure amount working on Cu removal at protruded space depends on Cu line width is the major cause, as shown in Fig.1. In this study, Cu removal can be independent on additive pressure carried out with Cu AFP technology and it offers Cu planarization with low pattern effect.

In this study, Cu AFP carries out with diluted 1.1M HNO_3 aqueous with 1E-4M BTA formulated as slurry. Depending on the mechanism of Cu AFP technology, Cu removal in AFP process depends onCu corrosion from HNO_3, Cu-BTA removal from a polishing pad and recovery efficiency of Cu-BTA chemisorbing onto Cu surface which depends on BTA concentration, as shown in Fig. 2. Fixed HNO_3 and BTA concentration offers almost the same Cu corrosion from HNO_3 and Cu-BTA recovery efficiency working on Cu removal during polishing, even as additive down force increases. However, Cu-BTA removal from a polishing pad also great depends on additive pressure amount till it gets saturated. Thus, Cu removal would be independent of additive pressure after Cu-BTA removal efficiency gets saturated, and it optimizes pattern effect reduced.

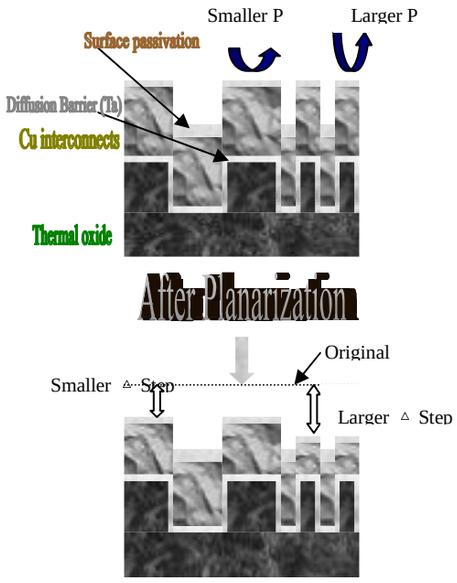

Fig.1 Pattern effect results from non-uniform additive pressure amount working on Cu removal at protruded space

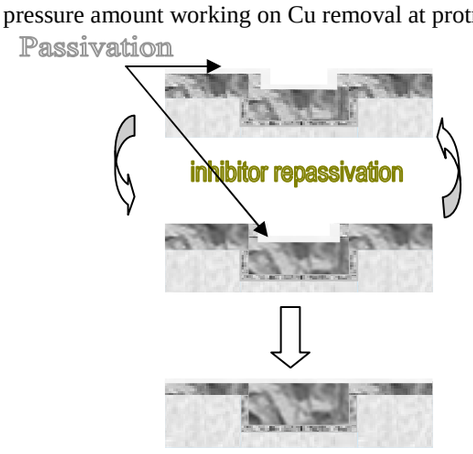

Fig.2 The mechanism of Cu AFP (1) Cu surface is passivated with an inhibitor (2) Passivation on protruded space is removed selectively during polishing, and underlying Cu could be corroded with oxidizer.(3) Planarization is achieved after cyclic reaction