

METHODS AND APPARATUS FOR BARRIER INTERFACE PREPARATION OF COPPER INTERCONNECT

ABSTRACT OF THE DISCLOSURE

[53] The embodiments fill the need of improving electromigration and reducing stress-induced voids of copper interconnect by enabling deposition of a thin and conformal barrier layer, and a copper layer in the copper interconnect. The adhesion between the barrier layer and the copper layer can be improved by making the barrier layer metal-rich prior copper deposition and by limiting the amount of oxygen the barrier layer is exposed prior to copper deposition. Alternatively, a functionalization layer can be deposited over the barrier layer to enable the copper layer being deposit in the copper interconnect with good adhesion between the barrier layer and the copper layer. An exemplary method of preparing a substrate surface of a substrate to deposit a functionalization layer over a metallic barrier layer of a copper interconnect to assist deposition of a copper layer in the copper interconnect in an integrated system in order to improve electromigration performance of the copper interconnect is provided. The method includes depositing the metallic barrier layer to line the copper interconnect structure in the integrated system, wherein after depositing the metallic barrier layer, the substrate is transferred and processed in controlled environment to prevent the formation of metallic barrier oxide. The method also includes depositing the functionalization layer over the metallic layer in the integrated system. The method further includes depositing the copper layer in the copper interconnect structure in the integrated system after the functionalization layer is deposited over the metallic barrier layer.

Figure 5D