COMPOSITE SILICON-METAL NITRIDE BARRIER TO PREVENT FORMATION OF METAL FLUORIDES IN COPPER DAMASCENE

ABSTRACT OF THE DISCLOSURE

A method of forming amorphous silicon spacers followed by the forming of metal nitride over the spacers in a copper damascene structure -single, dual, or multi-structure- is disclosed in order to prevent the formation of fluorides in copper. In a first embodiment, the interconnection between the copper damascene and an underlying copper metal layer is made by forming an opening from the dual damascene structure to the underlying copper layer after the formation of the metal nitride layer over the amorphous silicon spacers formed on the inside walls of the dual damascene structure. In the second embodiment, the interconnection between the dual damascene structure and the underlying copper line is made from the dual damascene structure by etching into the underlying copper layer after the forming of the amorphous silicon spacers and before the forming of the metal nitride layer. In the third embodiment, the ternary metal silicon nitride spacer is formed by etching after having first formed the amorphous silicon layer and the nitride layer, in that order, and then etching the passivation/barrier layer at the bottom of the damascene structure into the underlying copper layer. In all three embodiments, metal nitride reacts with amorphous silicon to form a ternary metal silicon nitride having an excellent property of adhering to copper while at the same time for forming an excellent barrier to diffusion of copper.

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