TSMC-95-104

A METHOD TO PREVENT VOLCANO EFFECT IN TUNGSTEN PLUG DEPOSITION

ABSTRACT OF THE DISCLOSURE

A method to prevent "volcano effect" in tungsten plug deposition is described. The method is applied to both the "contact plugs" as well as the "via plugs." For these purposes, the use of a nitrogen (N_2) plasma of a specific recipe is introduced. It is shown that the presence of the nitrogen plasma improves the titanium nitride (TiN) barrier layer through annealing, and nitrogen "stuffing" of the grain boundaries. It is also shown that it is not sufficient to use only (TiN) as a barrier layer for the conventional reasons of alleviating spiking and metal diffusion problems. In addition, a titanium (Ti) layer must be used prior to the deposition of the TiN layer in order to improve adhesion. This step also has the benefit of enhancing the titanium nitride barrier, and reducing the contact resistance (R_c) of the contact-plugs as well. Finally, because the nitrogen plasma process and the metal deposition are done in one and the same equipment, the advantages of shortened production time, increased thruput, and the attendant savings in cost are indicated.

(FIGURE 3 IS SUGGESTED FOR PUBLICATION)