ABSTRACT

A process for fabricating metal plugs, such as aluminum plugs, in a semiconductor workpiece. The invention is suitable for filling narrow, high aspect ratio holes, and the invention minimizes the formation of $TiAl_3$ or other products of interdiffusion between the plug and the wetting layer . First, an optional barrier layer is created by covering the bottom of a hole with a film containing titanium nitride doped with silicon. Second, a wetting layer is created by covering the side walls of a hole with a film containing titanium doped with silicon, in a Ti:Si molar ratio greater than 1:2. Preferably, the wetting layer is created by sputter deposition using a titanium sputtering target containing 0.1% to 20% wt silicon, most preferably 5% to 10% wt silicon. Third, the hole is filled by depositing a material consisting primarily of aluminum. The hole preferably is filled by sputter deposition using an aluminum sputtering target, optionally containing dopants such as copper. To facilitate filling the hole without voids, the aluminum sputter deposition preferably is performed "warm", i.e., with the workpiece at a temperature below the melting point of aluminum but high enough to promote reflow of the deposited material. The silicon atoms in the wetting layer inhibit the titanium from reacting with the aluminum, and the wetting layer facilitates filling the hole with the aluminum material without leaving unfilled voids.

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