

METHODS AND APPARATUSES FOR VOID-FREE TUNGSTEN FILL IN THREE-DIMENSIONAL SEMICONDUCTOR FEATURES

ABSTRACT

Disclosed herein are methods of filling a 3-D structure of a semiconductor substrate with a tungsten-containing material. The 3-D structure may include sidewalls, a plurality of openings in the sidewalls leading to a plurality of features having a plurality of interior regions. The methods may include depositing a first layer of the tungsten-containing material within the 3-D structure such that the first layer partially fills a plurality of interior regions of the 3-D structure, etching vertically and horizontally after depositing the first layer, and depositing a second layer of the tungsten-containing material within the 3-D structure after the vertical and horizontal etching such that the second layer fills at least a portion of the interior regions left unfilled by the first layer. Also disclosed herein are apparatuses for filling a 3-D structure of a semiconductor substrate with a tungsten-containing material having a controller with instructions for etching vertically and horizontally.

FIG. 4C