Abstract

A method for forming a void-free epitaxial cobalt silicide ($CoSi_2$) layer on an ultra-shallow source/drain junction. A patterned silicon structure is cleaned using HF. A first titanium layer, a cobalt layer, and a second titanium layer are successively formed on the patterned silicon substrate. The patterned silicon substrate is annealed at a temperature of between about 550°C and 580°C in a nitrogen ambient at atmospheric pressure; whereby the cobalt migrates downward and reacts with the silicon structure to form a $CoSi_2$/CoSi layer, and the first titanium layer migrates upward and the first titanium layer and the second titanium layer react with the nitrigen ambient to form TiN. The TiN and unreacted cobalt are removed. The silicon structure is annealed at a temperature of between about 825°C and 875°Cto convert the $CoSi_2$/CoSi layer to a $CoSi_2$ layer. The $CoSi_2$ layer can optionally be implanted with impurity ions which are subsequently diffused to form ultra-shallow junctions.

Fig 3