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INVESTIGATION OF THE INFLUENCE OF OXYGEN PLASMA ON THE COPPER SURFACE

Karola Richter[1], Christoph Kubasch[1], Johann-Wolfgang Bartha[1]

[1]Technische Universität Dresden, Dresden, Germany

karola.richter@tu-dresden.de

With the continuing miniaturization in the microelectronic industry copper wires became an essential part in manufacturing of high end logic chip in the past decade. Copper lines have a higher conductivity and they are less susceptible to electromigration in comparison to the former used aluminum lines. As a result of the successful integration of copper lines in high end logic chips, copper wires have also been introduced in a broader field of semiconductor devices in the last few years. In the fabrication of high end logic chips the copper wires are made by means of the so called Damascene Technology. In case of less integrated devices Pattern Plating is the favorite process to create patterns of copper. The main advantage of Pattern Plating is the simple process flow without patterning of copper by etching or chemical mechanical polishing (CMP). In both cases an electrochemical deposition of the copper takes place. The properties of the seed-layer surface are of essential importance for the quality of the deposited copper layer.
It has to be ensured that the copper seedlayer is free of particles and photoresist residues. Furthermore the copper surface must have a good wettability. All these demands can be meet by means of an oxygen plasma process before electroplating.
In this work the influence of oxygen plasma on the copper surface has been studied. The copper surface was characterized by means of contact angle measurement in combination with the determination of the surface energy, surface roughness measurements, and x-ray photoelectron spectroscopy against different plasma conditions. In the experiments it has been shown that the oxygen plasma reduces the carbon contamination on the copper surface. But primarily a copper(I)oxide layer as dense as possible should be created on the copper surface. Such a copper(I)oxide, which was formed during the plasma process, contributes to a high wettability. Long term investigations showed that copper(I)oxide is transformed to copper(II)oxide along with an increasing carbon contamination on the surface leading to a lower wettability.

Keywords
copper surface
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wettability