



Applied Producer[®] Onyx[™] Film Treatment

The Producer Onyx film treatment for low- κ films demonstrates Applied Materials' continued momentum in innovation and technology leadership by launching a differentiated technology into a new segment within the dielectrics market.

As interconnects continue scaling, reducing the κ value of each insulating (dielectric) layer becomes more critical to enable faster device speed. Porous low- κ dielectrics are the foundation for building copper interconnects. For the 2x nm technology node, ultra-low- κ materials ($\kappa \sim 2.2$) will be needed to achieve the requisite capacitance reduction. In fabricating a 10-12 metal-layer structure, these low- κ materials can be exposed to more than 150 process steps and must then withstand the stresses of packaging and assembly. Processing exposes the dielectrics to different chemistries and plasmas, which alter the chemical structure of these layers and can lead to a decrease in their dielectric insulating performance. In addition, process effects can also result in moisture introduction, which leads to high leakage and low reliability. Therefore, treating the film to counteract the changes in its chemical structure becomes increasingly important for electrical performance.

Low- κ film for the 2x nm node will also have to be mechanically stronger to meet packaging yield requirements in view of trends in packaging processes. The semiconductor industry is eliminating lead from chip packaging in response to environmental concerns. Lead-free solder materials exert greater stresses on the packaged chip and in the interconnect. In addition, the packaging industry is evaluating the use of copper pillar bumps, which improves reliability but can transmit even higher stresses to the interconnect.

Applied Producer Onyx is a novel process for treating the low- κ film to restore its chemical integrity and enhance its robustness. The process treats not only the surface of the film but also the bulk, enabling industry-leading integrated κ value, while enhancing key structural properties like modulus and hardness.

Producer Onyx treatment enables:

- Full realization of the benefits of low- κ material in achieving industry-leading integrated κ value
- Low- κ dielectrics robust enough to withstand numerous interconnect fabrication steps and back-end packaging processes at the 2x nm node and beyond.
- Improved RC behavior

In the fab, the Onyx process offers the productivity advantage of a short cycle time; in the larger production context, it enhances the productivity of other processes (e.g., etch) by counteracting effects that would otherwise decrease yield.