Tungsten Plug Studied by Transmission X-ray Microscope

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An energy-tunable transmission hard X-ray microscope with spatial resolution better than 60nm has been developed jointly by NSRRC and Xradia Inc. The x-ray sourced from the superconducting wavelength shifter beamline at Taiwan Light Source can be tuned from 6 keV to 20 keV. The microscope utilizes three different zone plates to cover the 8-11 keV designed operating x-ray energy range, which is well suited for imaging most IC materials; Cu, Ta, W, Ga, As and Ge etc. The energy tunability of the x-ray microscope allows one to image a specific IC material by differential absorption contrast, which takes image(s) below and above an x-ray absorption edge of an element and then processing the images, such as subtracting one image taken below the absorption from another taken above the absorption edge with suitably scaling the magnification of the two images. In this paper, an example of differential absorption contrast imaging of copper interconnects of 110 nm width is demonstrated.

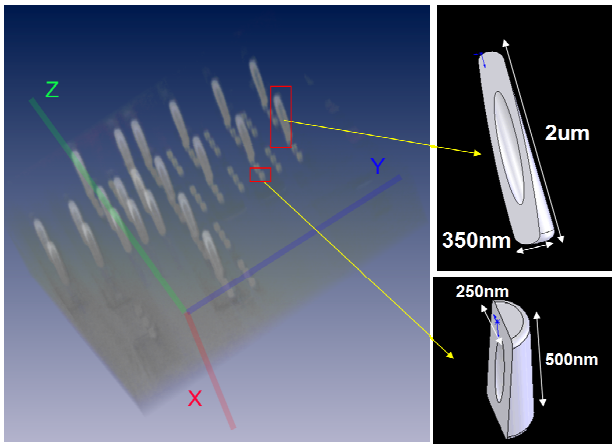

Figure 1. 3D rendering of tungsten plug with "key hole" and the diagrams showing the structure of the key hole-right up, the tungsten plug with 350nm- diameter. Right bottom, the tungsten plug with 250nm-diameter.

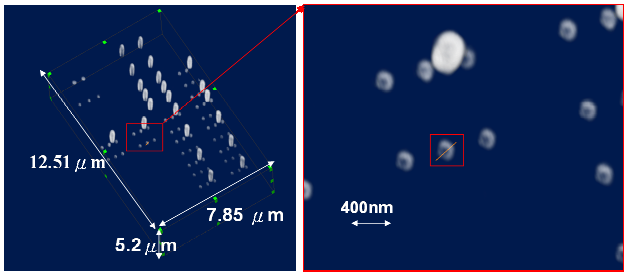

Figure 2. The 3D rendering of tungsten plug is plotted with higher threshold. The wire made of copper-aluminum alloy is removed from the rendering; the tungsten distribution is shown. The red region of left picture is the region of right picture. The red region in the right picture is the tungsten plug, which is analyzed in Figure3.

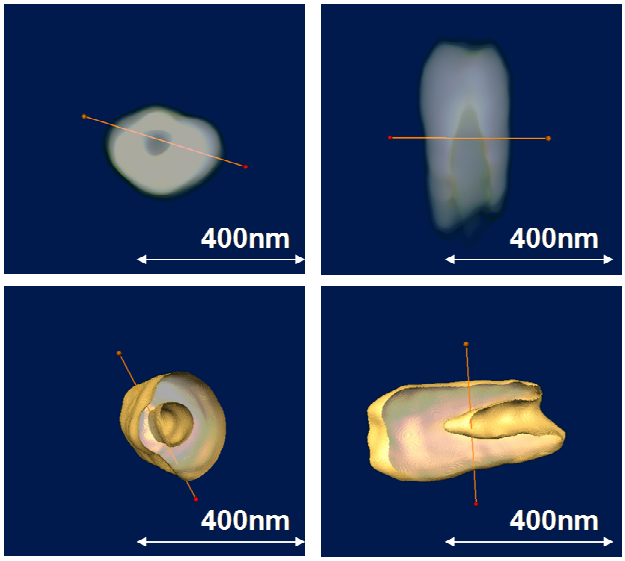

Figure 3. The top-view and side view of the tungsten plug displayed in voxel mode (top) and iso-surface (bottom) mode. The orange line indicates the region of cross-section, showing the resolution is close to 60nm.

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