Measurement of Nanograin Orientations: Application to Cu Interconnects and Nanoparticle Phase Identification

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ABSTRACT

Today, orientation maps of polycrystalline material are necessary for a better understanding of, for example, the formation of voids in the interconnects modern electronic devices. In this context, EBSD (Electron BackScattering Diffraction) has proved to be a powerful tool to measure grain orientation, but its spatial resolution is limited at the best to a diameter of about 10 nm. As new generations of devices have dramatically reduced in size, new tools are required to meet these spatial resolution specifications.

In this work the NanoBeam Electron Diffraction (NBED) coupled with the ASTAR system is used to obtain orientation maps. The ASTAR system is an automatic crystallographic orientation indexing tool developed for the transmission electron microscopes [1]. It can operate using the precession diffraction mode to provide quasi-kinematical patterns. Experiments were performed on two different microscopes: a JEOL 2010 FEF with a FEG (Field Emission Gun) and a JEOL 3010 equipped with a LaB6 filament. With these respective microscopes, diffraction patterns using a beam size of 3 nm (JEOL 2010 FEF) and 10 nm (JEOL 3010) can be achieved and indexation of grains or nanoparticles around 10-20 nm can be obtained.

Orientation maps obtained with different configurations (microscopes, voltage, camera length, with and without precession) will be compared. Two studies will be presented: the first one deals with polycrystalline copper interconnections as used in the 45nm technological node, the second one, illustrates the phase identification in nanoparticles.

REFERENCES


Key words: TEM precession scanning, Cu interconnect, phase identification