doi:10.1017/S1431927611006349
Microsc. Microanal. 17 (Suppl 2), 2011

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

G. Brunetti*, J.L. Rouvière**, R. Galand***, L. Clément***, C. Cayron****, E.F. Rauch*****, D. Robert****, J.F. Martin****, F. Bertin*, A. Chabli*

* CEA-Leti, MINATEC Campus, 17 rue des Martyrs – F-38054 Grenoble Cedex 9
** CEA-Grenoble, INAC/SP2M/LEMMA, F-38054 Grenoble
*** STMicroelectronics, 850 Rue Jean Monnet, F-38920 Crolles
**** CEA, DRT, LITEN, Minatec Campus, F-38054 Grenoble
***** Université de Grenoble, Lab. SIMaP (G-INP-UJF-CNRS), Domaine Univ., BP 75, F-38402 St Martin d'Hères Cedex

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 [1] is an automatic crystallographic orientation and indexing tool developed for the transmission electron microscopes. It can operate using the precession electron diffraction (PED) mode to provide quasi-kinematical patterns [2]. This type of diffraction patterns presents a great interest for the materials investigation because they procure more reliable information for the recognition of crystallographic structures or for a better determination of the crystal orientation. Experiments were performed on two different transmission electron microscopes: the first one is a JEOL 2010 FEF with a FEG (Field Emission Gun) and a Omega energy filter in the column; the second one is 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, with different precession angles) will be compared. Two studies will be presented: the first one deals with polycrystalline copper interconnections as used in the 45nm technological node, an example of orientation maps determined by EBSD and ASTAR is given Figure 1. The second one illustrates the phase identification in nanoparticles [3, 4].

References

[1] E. F. Rauch, J. Portillo, S. Nicolopoulos, D. Bultreys, S. Rouvimov, P. Moeck, *Zeitschrift für Kristallographie*, 225 (2010) 103
[2] R. Vincent, P.A. Midgley, *Ultramicroscopy*, 53 (1994) 271
[3] This work has been supported by the French National Research Agency (ANR) through the "Recherche Technologique de Base" Program.
[4] This work was supported by the European EUREKA/CATRENE program in the frame of the CT206 UTTERMOST project.

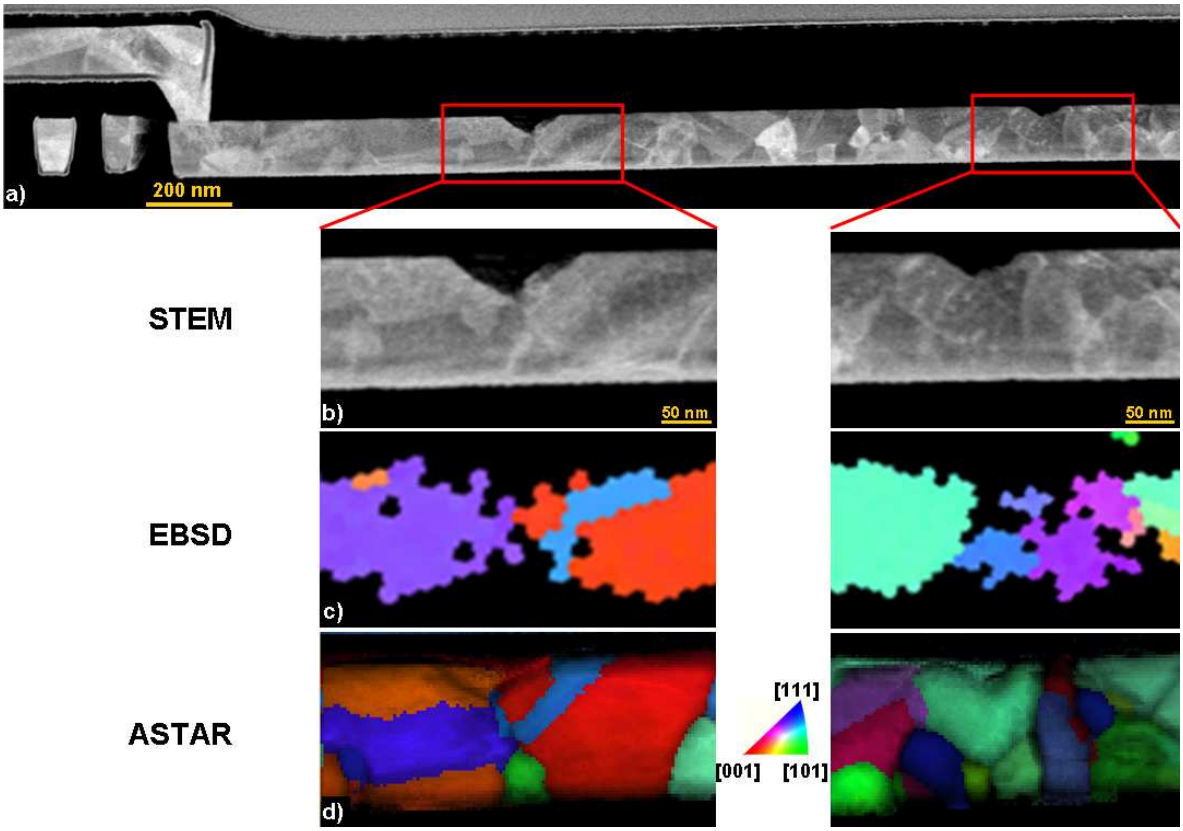

FIG. 1. Copper interconnect investigated by STEM (a), enlargement of the regions of interest (b) and determination of the orientations of two regions of interest (presence of voids) by EBSD (c) and ASTAR (d)

https://doi.org/10.1017/S1431927611006349 Published online by Cambridge University Press