doi:10.1017/S1431927610057855
Microsc. Microanal. 16 (Suppl 2), 2010

Atomic-Resolution Characterization of Interfaces in Pt Precipitates in Sapphire Annealed at 1600°C

M.K. Santala,* V.R.Radmilovic,** R.Giulian,*** M.C. Ridgway,*** A.M. Glaeser,**** and R. Gronsky****

* Condensed Matter & Materials Division, Lawrence Livermore National Laboratory, CA, 94551
** National Center for Electron Microscopy, Lawrence Berkeley National Laboratory, Berkeley, CA, 94720
*** Department of Electron Materials Engineering, Australian National University, Canberra, ACT, Australia
**** Department of Materials Science and Engineering, University of California, Berkeley, CA, 94720,

Despite efforts to characterize ceramic-metal interfaces, e.g. [1-3], the understanding of such structures lags far behind that of bulk constituents. The detailed study of a model system – platinum in sapphire (single crystal α-alumina) – was motivated by this relative dearth of information on the structure of metal-oxide interfaces. Platinum precipitates in sapphire that had been annealed at 1600°C in air were imaged with the TEAM 0.5 microscope at the National Center for Electron Microscopy. Atomic-resolution phase-contrast images of the sapphire-Pt interfaces were produced and exit wave reconstructions of through-focal series (FIG 1) were compared to simulated images to extract quantitative information about structure and bonding at the interfaces. The nano-precipitates (<100nm diameter) were formed in sapphire by high-energy ion implantation followed by thermal annealing in air. Processing parameters anticipated to yield a large number of Pt precipitates with the orientation relationship $(0001)_{sapphire}||(111)_{Pt}$; $[10\ \bar{1}0]_{sapphire}||[1\ \bar{1}0]_{Pt}$ [4,5] were used to produce the specimens. The presence of large numbers of precipitates with this relatively high-symmetry orientation relationship increased the likelihood that interfaces could be studied with both phases simultaneously on a low-index zone axis, as in FIG 1. The information derived from the high-resolution imaging and analysis will be related to a quantitative description of the precipitate morphology [6].

References

[1] C. Scheu et al., *J. Mater. Sci.*, 41 (2006) 5161-68.
[2] A. Avishai, C. Scheu, and W. Kaplan, *Acta Mat.* 53 (2005) 1559-69.
[3] S. Ramanathan et al., *Phil. Mag. A* 81 (2001), 2073-94.
[4] M. K. Santala et al., *Scripta Mat.* 62 (2010) 187-90.
[5] C.W. White et al., *J. App. Phys.* 93 (2003) 5656-69.
[6] This research was supported by the Metals & Metallic Nanostructures Program of the National Science Foundation through Grant No. 080506. M.S. was supported by an NSF Graduate Research Fellowship for most of this project. The assistance of the staff of the National Center for Electron Microscopy is gratefully acknowledged.

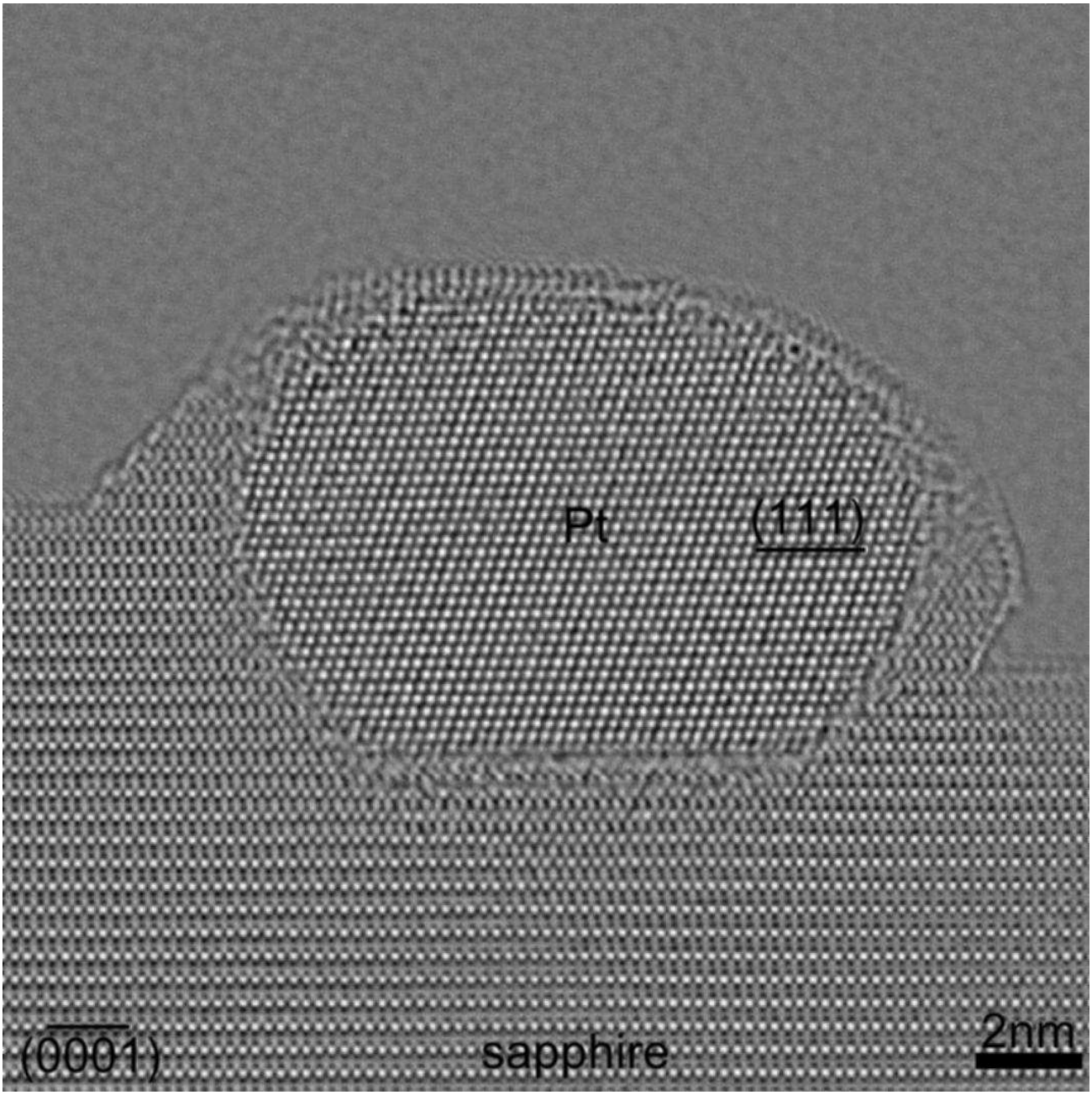

FIG. 1. Phase image produced by exit wave reconstruction of a through focus series taken with the TEAM 0.5 microscope at the National Center for Electron Microscopy. The image shows a Pt precipitate with the orientation relationship $(0001)_{sapphire}\|(111)_{Pt};[10\ \bar{1}0]_{sapphire}\|[1\ \bar{1}0]_{Pt}$ in sapphire after 10 hours at 1600°C. The materials are viewed along the $[10\ \bar{1}0]_{sapphire}$ and $[1\ \bar{1}0]_{Pt}$ zone axes.

https://doi.org/10.1017/S1431927610057855 Published online by Cambridge University Press