DOI: 10.1017/S1431927605506755
Microsc Microanal 11(Suppl 2), 2005

Orientation Imaging of Recrystallization, Grain Growth and Phase Transformations using In-Situ Heating

Matthew M. Nowell*, David P. Field**, Stuart I. Wright*, Damian Dingley*, Paul Scutts* and Seiichi Suzuki***

* EDAX-TSL, 392 E 12300 S, Draper, UT 84020 USA
** School of Mechanical and Materials Engineering, Washington State University, 239C Dana Hall, Pullman, WA 99164 USA
*** TSL Japan, 6-29-8 Haramachida, Machida Tokyo, 194-0013 Japan

The automated analysis of electron backscatter diffraction (EBSD) patterns for orientation imaging has become a well established technique for materials and earth sciences. This technique allows for quantitative microstructural measurements of crystal orientation and texture, grain boundary character and classification, and phase identification. Combining this technique with in-situ heating of the sample allows for the direct observation and comparison of microstructural transitions that can occur during phenomena such as recrystallization, grain growth, and phase transformations. While the concept of combining in-situ heating and orientation imaging is not new [1-3], recent advances in EBSD camera technology and corresponding data acquisitions speeds have allowed for useful orientation imaging data to be collected within a couple of minutes. Rather than analyzing these dynamic processes through before and after comparisons, orientation imaging scans can be collected repeatedly during the heating and corresponding transition period.

For EBSD analysis, typically the sample is tilted to 70° towards a phosphor screen for pattern collection. Consideration of this sample tilt is necessary when designing the heating stage for in-situ orientation imaging. In addition often the samples that are observed are initially deformed with small (less than 1μm) features of interest. The stage must be stable enough at temperature to observe these features without significant drift. Software control for the heating unit, drift control, and automated collection of multiple scans has also been developed.

The recrystallization of heavily deformed copper, recrystallization and grain growth in aluminum, and phase transformations in cobalt have been observed with in-situ orientation imaging. In the copper sample, twinning played an important role in microstructural evolution and the formation of strain-free regions. In the aluminum sample, an initial period of recrystallization occurred followed by multiple stages of thermally activated grain growth. In the cobalt samples, the HCP to BCC transition was observed during both heating and cooling of the specimen. The orientation relationships that occur during the transition were measured. The HCP and BCC microstructures were also measured and compared at different times and temperatures.

[1] F. J. Humphreys and M. Ferry, *Mat. Sci. Forum* 217-222 (1996) 529.
[2] F. Springer and M.Radomski, *Mat. Sci. Forum* 273-275 (1998) 497.
[3] D.P. Field and M. M. Nowell, *Proceedings of the Fourth International Conference on Recrystallization and Related Phenomena*, Japan Institute of Metals, (1999) 851.
[4] M.M. Nowell et al., *Mat. Sci. Forum* 467-470 (2004) 1401.
[5] G.G.E. Seward et al., *Acta Materialia*, 52 (2004) 821.

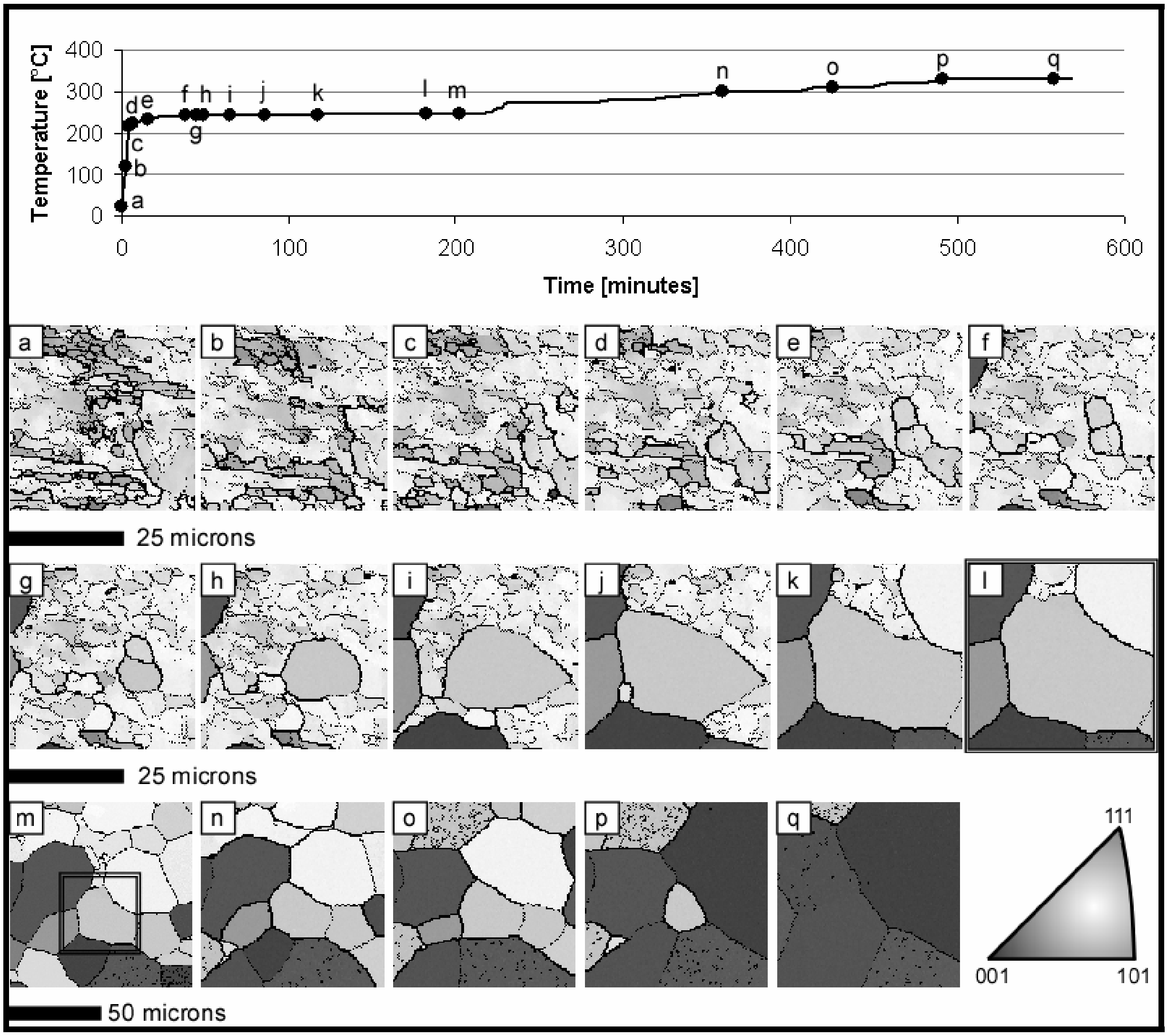

FIG. 1. Orientation maps from aluminum at different times and temperatures as shown.

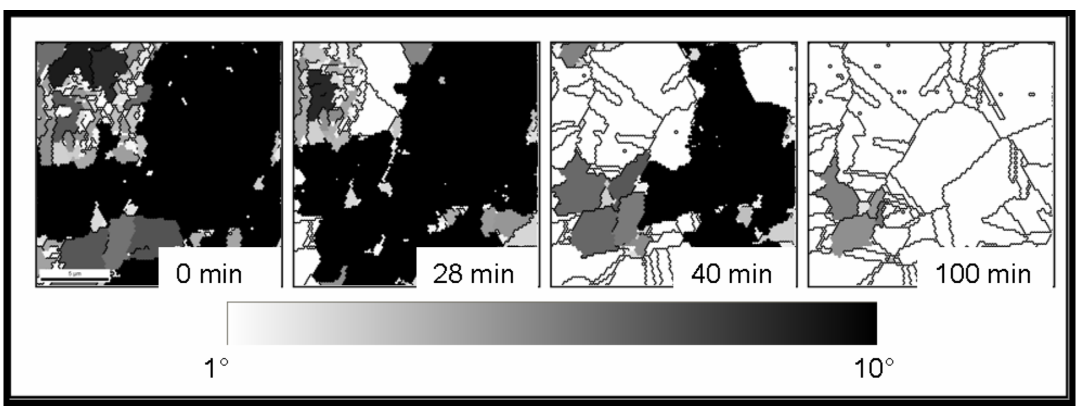

FIG. 2. Grain orientation spread (GOS) maps from copper heated at 155°C for different times.

https://doi.org/10.1017/S1431927605506755 Published online by Cambridge University Press