

Processing and Properties of Materials with Ultrafine Grain Sizes

Terence G. Langdon, University of Southern California
NSF Award DMR-0243331

Equal-Channel Angular Pressing (ECAP)

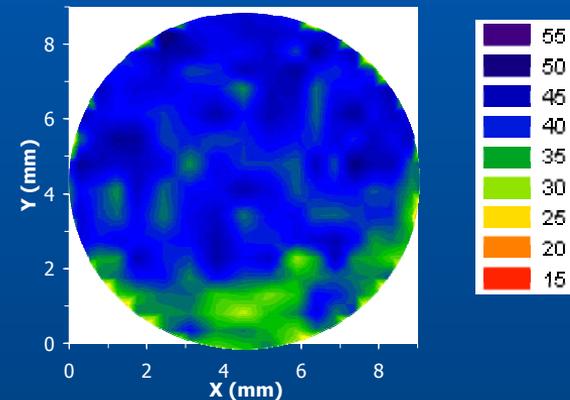
- ECAP is used to process ultrafine-grained microstructures.
- Grain sizes are generally in the range 100-1000 nm.
- Hardness measurements show homogeneity is achieved more easily in pure aluminum than in an Al-6061 alloy: illustrations (right) show hardness contour maps after 1 pass of ECAP.
- Materials processed by ECAP exhibit high strength at ambient temperature.



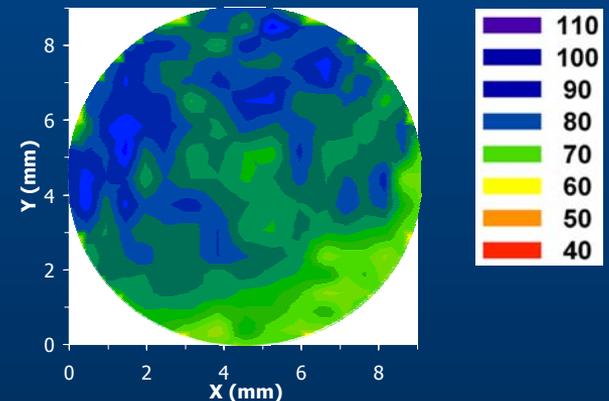
C. Xu, M. Furukawa, Z. Horita and T.G. Langdon, "Using ECAP to Achieve Grain Refinement, Precipitate Fragmentation and High Strain Rate Superplasticity in a Spray-Cast Aluminum Alloy," *Acta Materialia* **51**, 6139-6148 (2003).

C. Xu, M. Furukawa, Z. Horita and T.G. Langdon, "Severe Plastic Deformation as a Processing Tool for Developing Superplastic Metals," *Journal of Alloys and Compounds* **378**, 27-34 (2004).

Pure Al: 1 pass



Al-6061: 1 pass



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Training

- 2 graduate students, 1 post-doc and 2 senior visitors are participating in this research.
- A collaboration is in place with Kyushu University, Japan.



Impact

- Invited lectures describing the results were presented at international conferences in the Czech Republic, Japan, Poland, Spain, U.K., U.S.A.
- The P.I. is co-organizer of conferences on Ultrafine-Grained Materials in Spain (2003), Charlotte, N.C. (2004), Ukraine (2004), China (2004), Japan (2005), Canada (2006).
- The post-doc and graduate student won awards for best oral presentation and best poster at the TMS Annual Meeting, Charlotte, N.C. (2004).



Dr. Cheng Xu (third from right) and graduate student Megumi Kawasaki (second from right) together with other TMS awardees at Charlotte, N.C. (2004).



Prof. Langdon, Prof. Furui, Megumi Kawasaki, Dr. Cheng Xu, Praveen Kumar and Dr. Karodi Venkateswarlu at the University of Southern California.