Report: Crystallization Kinetics in Bulk Metallic Glasses, Me-248

During our beamtime (12 shifts) in 8-12 June, 2001, the crystallization kinetics of Pd40Ni10Cu30P20 bulk metallic glass has been studied in situ using angle-dispersive X-ray powder diffraction at beamline ID30. A large volume Paris-Edinburgh press and the CCD detector were used. The results obtained are briefly described below.

The crystallization kinetics of the glass has been investigated by in situ high-pressure and high-temperature X-ray powder diffraction measurements using synchrotron radiation under pressure 0.5 GPa.[1] Each run consists of an isothermal room-temperature compression followed by heating to a temperature of 1023 K above melting temperature. And then we rapidly cooled the sample temperature down to a given temperature in the range of 700-873 K. When the sample temperature reached the setting one, and XRD pattern was recorded per every 30 seconds. For example, at 773 K, after 3 min. the CCD image shows pure amorphous structure. After 3.5 min. shape spots due to one single crystal appear. The spots can be indexed to a fcc structure. Such spots remain until about 60 min. and then they disappear again. In other temperatures similar behavior was observed too. The main findings during this experiment are (1) Single nucleation event in undercooled metallic glass was directly observed. To the best of our knowledge, this is for the first time in metallic glass system, in which such experiments are very difficulty.[2,3] (2) Annihilation of nuclei which has a size smaller than the critical value was directly detected. This is a direct proof of the classic nucleation theory developed 5 decade ago.[4] All data, containing 30 CD, are analysing. Such results are extremely exciting. We request to continue this project for another 15 shifts at the beamline ID30 in Feb. 2002.

1. J.Z. Jiang et al. in preparation
2. S.T. Yau and P.G. Vekilov, Nature **406,** 494 (2000).
3. D.W. Oxtoby, Nature **406,** 464 (2000).
4. D.J. Turnbull, J. Chem. Phys. **17,** 71 (1949).