Phase Transformation in Sn Single Crystal

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Sn undergoes a phase transformation from its usual metallic (β) phase to lower temperature (α) phase (”gray” Sn). The β to α transformation normally requires large undercooliing over prolonged periods of time, and is accompanied by a 27 % volume expansion. In spite of many investigations on the transformation, its mechanism, whether by martensitic transformation or by atomic motion, has not been cleared. Pulsed neutron diffraction experiments were performed at SXD, ISIS to understand the mechanism and kinetics of the transition. In the experiments, β-Sn single crystals inoculated with seeds of α-Sn were kept at 230K at which the transition rate reaches maximum, and scattering intensities for the diffraction pattern were collected every forty minutes in the process of β to α transformation. Figure 1 shows time dependence of the intensities for $(131)_\alpha$ reflection in growing α-Sn, with a result of fitted line by so-called Avrami[1] or Johnson-Mehl equation, $F(t) = 1 - \exp(At^k)$, with $k = 3$. The value indicates three -dimensional nucleation of α-Sn region. The present experiment is the first example of time resolved structural analysis measurement in the β to α transformation of Sn.

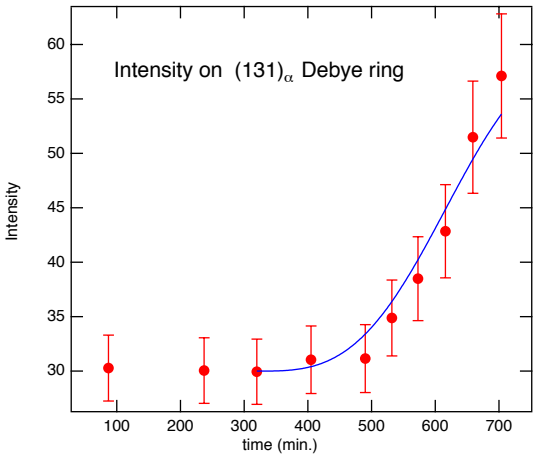

Fig. 1 Time dependence of the intensities for $(131)_\alpha$ reflection in growing α-Sn.

References

[1] M.Avrami, J. Chem. Phys. **9**, 177 (1941).