<일반연제 2-6>

Unstability of IV-VI Compound Semiconductor

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$Pb_{1-x}Eu_xTe$ alloys are important for the fabrication of device involving PbTe/EuTe superlattices and $PbTe/Pb_{1-x}Eu_xSe_yTe_{1-y}$ heterostructures.[1] $Pb_{1-x}Eu_xTe$ alloys with $0.4<x<0.51$ grown on BaF2 substrate showed spinodal decomposition.[2] The directions of decomposition are <111> and <110> where the elastic energy is minimum. In this work, the image simulation was carried out using multi-slice method for several models of the decomposed phase and critical temperature of spinodal decomposition was calculated.

$Pb_{0.55}Eu_{0.45}Te$ films were grown on the (111) surface of BaF_2 substrates using MBE at a temperature of 573 K. Cross-sectional samples for TEM were prepared by mechanical thinning and subsequent ion milling. TEM observation was carried out using Philips EM 430 transmission electron microscope. The calculations of the image were carried out using IBM main frame computer.

The model used for the compositional modulation along the <111> direction (see Fig. 1) is step function profile. Images of the (110) plane were obtained for thicknesses in range of 0.92 - 13.8 nm, in steps of 0.92 nm for several defocusing conditions. Using pendollosung plot, we have found that the best contrast for spinodal decomposition is obtained for a thickness of ~13 nm. The stimulated images at 13.8 nm with several defocusing values are shown in Figs. 2 a-d. Three models were used to calculate the image of the spinodally decomposed phase along the <1-10> direction. Based on the results of the simulated images, we can conclude that the composition profile of spinodal decomposition was a

step function in both <111> and <1-10> directions. Using a Delta Parameter (DLP) method[3], we described free energy and calculated critical temperature.

[1] J Heremans and DL Partin, Phys Rev B37, 6311 (1988).

[2] L Salamanca-Young, S Nahm, M Wuttig, DL Partin and J Heremans, Phys Rev B39, 10995 (1989).

[3] GB Stringfellow, J Phys Chem Solids 34, 1749 (1973).

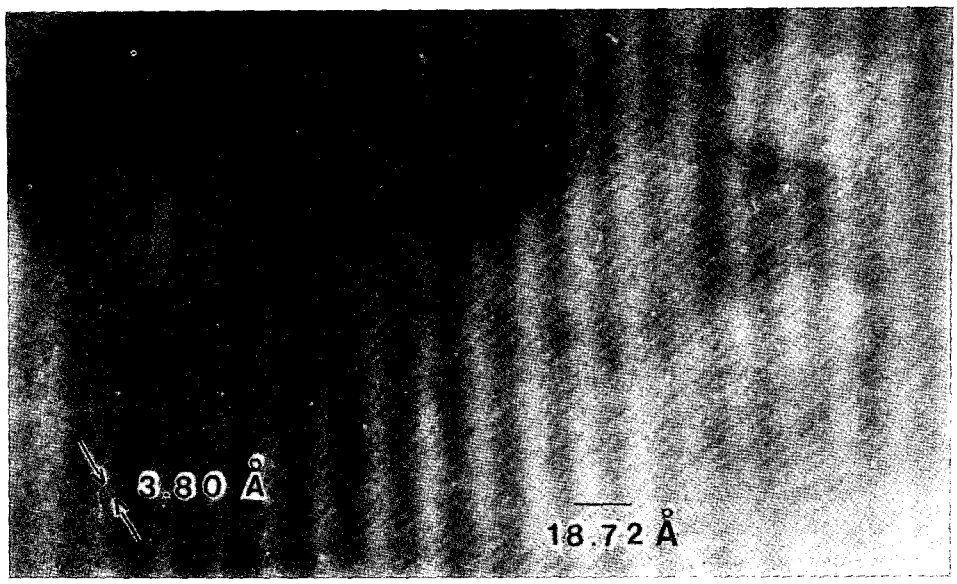

Fig. 1 (1-10) lattice image of a Pb0.57Eu0.43Te alloy showing periodicity of 1.87 nm along the <111> direction.

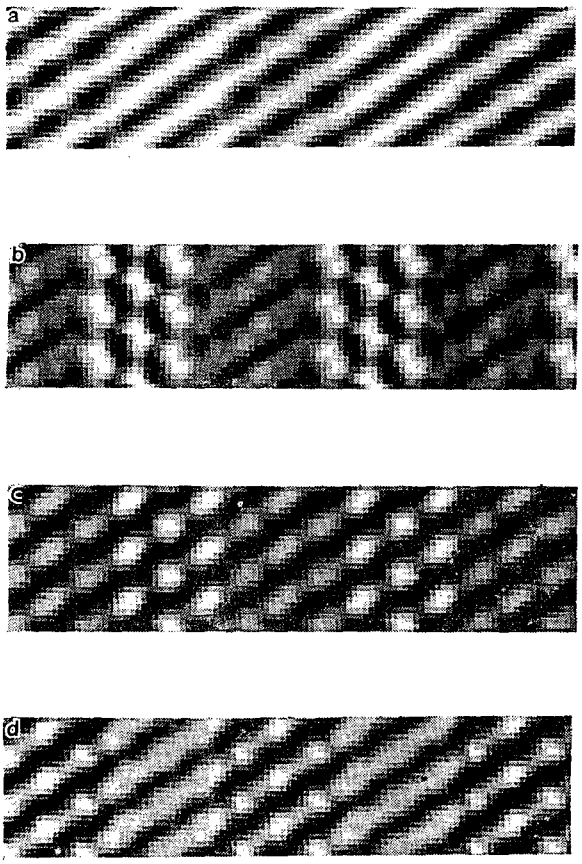

Fig. 2 (1-10) simulated images of Pb1-xEuxTe alloy (x=0.5) at 13.8 nm with different defocusing values, a) -10 nm, b) -34 nm c) 58 nm and d) 76.9 nm.