NEW MODEL OF LPE GROWTH:
GROWTH RATE CALCULATION

A.Ju. Malinin, O.B. Nevsky, V.T. Khrjapov,
M.S. Minadjinov, and A.L. Noghinov
Department of Semiconductor Materials,
Moscow Institute of Electronic Techniques,
Moscow 103498, USSR

(Received February 21, 1978)

Expressions for the LPE growth rate are developed on the basis of the new steady-state growth model assuming nucleation in the solution. The solution thickness can be calculated at which the LPE growth rate reaches a maximum for any solution cooling rate. The initial and the volume nucleation parameters, formation times, critical supersaturations and supercoolings of the solution have been determined from experimental GaP and GaAs LPE data. Calculated growth rates fit very closely with experimental rates of GaP and GaAs LPE growth.

Key words: liquid phase epitaxy, growth model, nucleation, growth rate, critical supersaturation.
Introduction

In some cases it is essential to get maximum rate of LPE growth. For example it was shown that the efficiency of GaP diodes were increased with the solution cooling rate \( q \). Calculated LPE growth rates on the basis of the nonsteady-state model assuming the diffusion of the solute to the substrate significantly differ from the experimental data \(2, 3\). In previous work \(4\) the new steady-state model assuming the nucleation in the growth solution was developed. In this paper an attempt has been made to obtain the expressions for the LPE growth rate.

LPE Growth Rate Calculations

The LPE layer thickness \( d \) from \(4\) is equal to

\[
d = dt F = h_o \cdot A \cdot \Delta C \cdot F
\]

(1)

where \( h \) - solution thickness, \( F \) - growth efficiency, \( A \) - growth parameter, \( \Delta C \) - solute concentration difference from the liquidus curve, \( d_t \) - theoretical maximum of layer thickness.

For LPE growth due to solution cooling with a constant rate \( \alpha \), the value \( \Delta C = m \cdot \alpha \cdot t \), where \( m \) - slope of the liquidus curve (at.fraction/K) and \( t \) - time. The rate of LPE growth \( W \) is given by

\[
W = \frac{d(d \cdot F)}{dt} = h_o \cdot A \cdot m \cdot \alpha \cdot F
\]

(2)

The initial non-stationary LPE growth is