Investigation of Kinetic Transitions during $\gamma \rightarrow \alpha$ Transformation in Fe-C-Mn Alloys Using Decarburization

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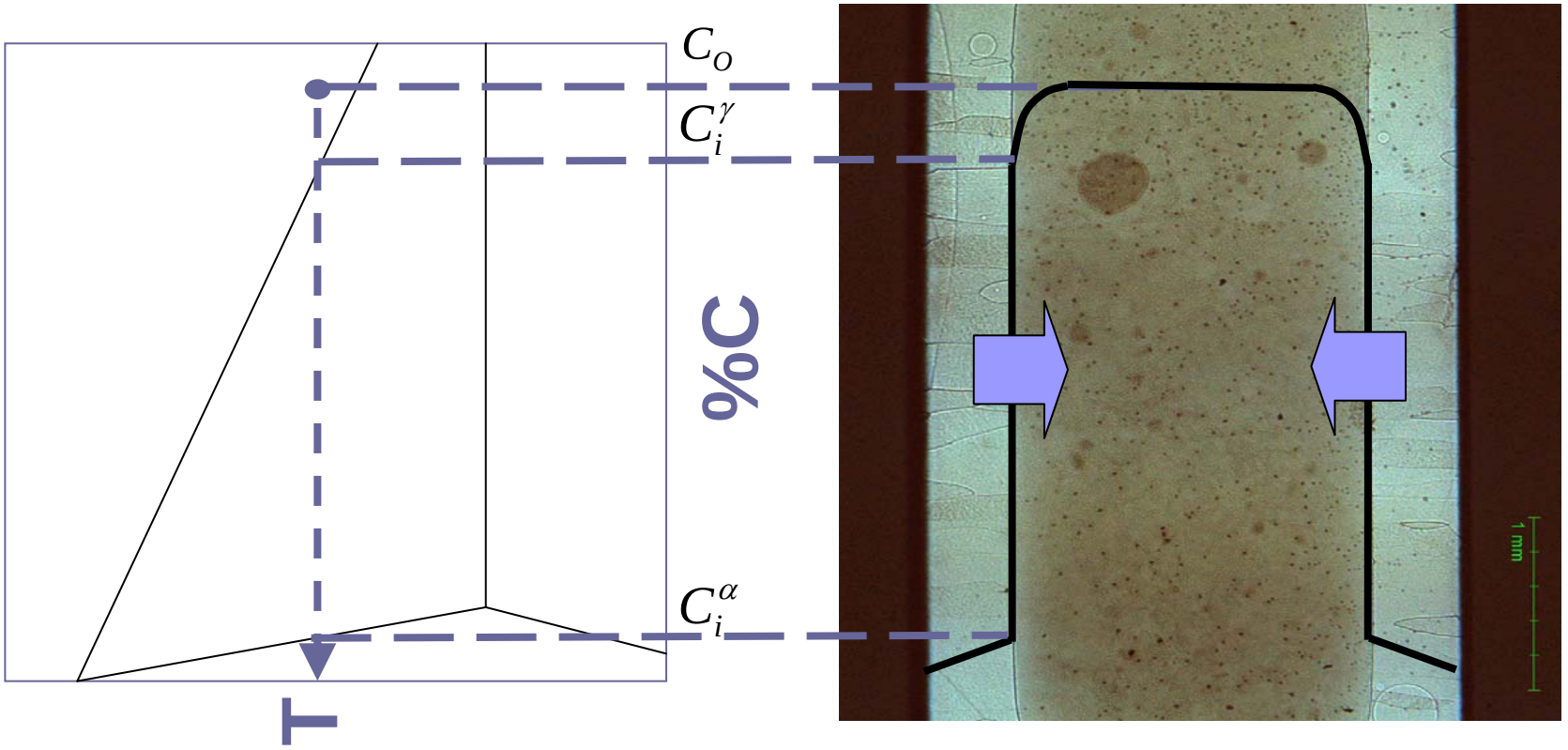
Outline:

- Introduction to the Decarburization method.
- Transition from PE to LENP due to Spike Build up in Fe-Mn-C.
- Long-lived PE state due to limited interface capacity in Fe-Mn-C.
- New results on the Fe-Mn-N system.

The Decarburization Method

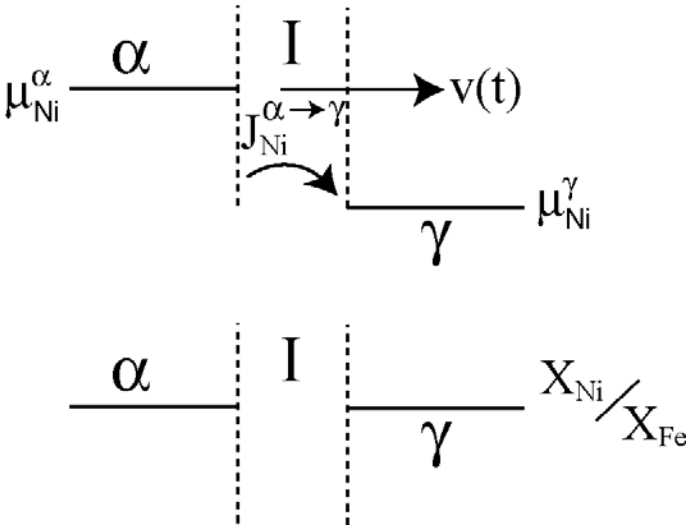


2. Transition from PE to LENP due to spike build up.

Single Jump Model

(Hutchinson, Fuchsmann and Brechet, Met. Trans. A, 35,1211)

- At high temperatures, the build up of the spike takes place within few minutes. Decarburization measurements would then follow LENP limit for all measurable times (> 2 min).

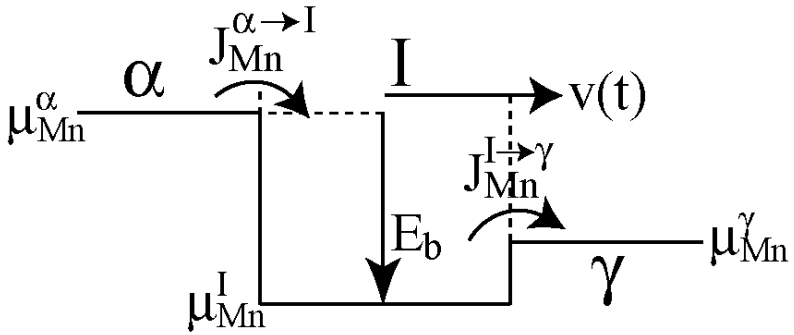


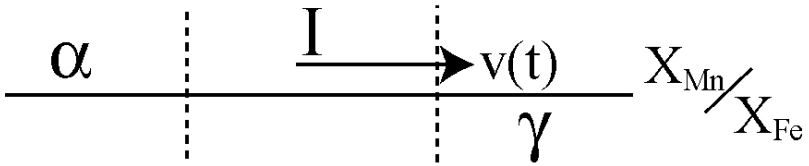
- At low enough temperatures, one should be able to observe PE at short times and LENP at longer times.

$$J_{Ni}^{\alpha\rightarrow\gamma} = \frac{X_{Ni}\cdot M_{Ni}^{Trans-\text{int}}}{V_m}\cdot\frac{\left(\mu_{Ni}^{\gamma}-\mu_{Ni}^{\alpha}\right)}{\delta}\left(1-\exp\left(\frac{-D_{Ni}^{Trans-\text{int}}}{v\delta}\right)\right)$$

Two Jump Model:

- Two jumps one into the interface and one out of the interface.
- Allow for segregation at the interface.
- Assign a capacity for the solute at the moving interface, *X**
- *X** increases linearly with C content.

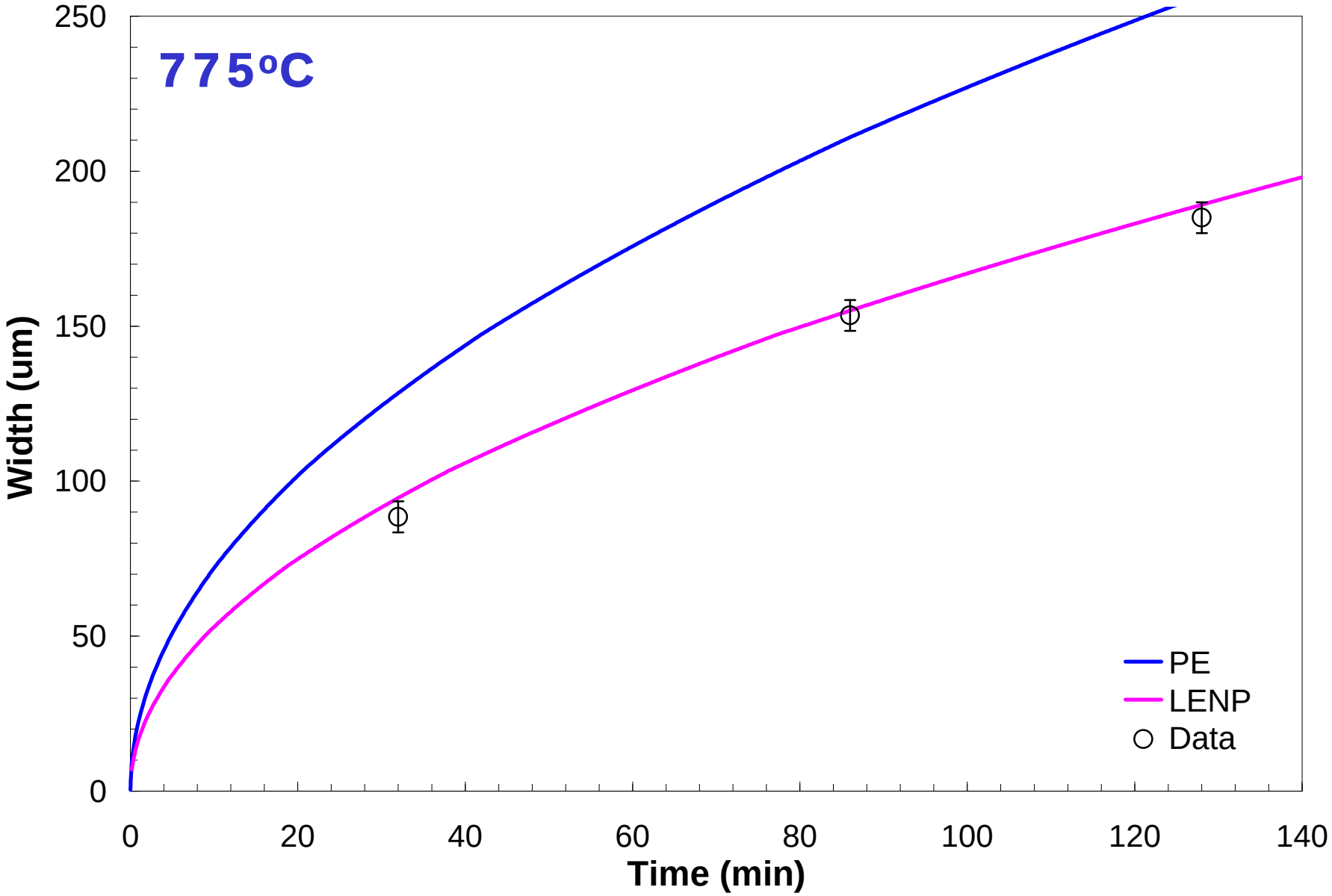




$$J_{Mn}^{\alpha\to I} = \frac{X_{Mn}^{b}\cdot M_{Mn}^{Trans-\text{int}}}{V_m}\cdot\frac{\left(\mu_{Mn}^{I}-\mu_{Mn}^{\alpha}\right)}{\delta}\left(1-\exp\left(\frac{-D_{Mn}^{Trans-\text{int}}}{v\delta}\right)\right)\left(1-\frac{X_{Mn}^{I}}{X_{Mn}^{*}}\right)$$

$$J_{Mn}^{I\to\gamma} = \frac{X_{Mn}^{I}\cdot M_{Mn}^{Trans-\text{int}}}{V_m}\cdot\frac{\left(\mu_{Mn}^{\gamma}-\mu_{Mn}^{I}\right)}{\delta}\left(1-\exp\left(\frac{-D_{Mn}^{Trans-\text{int}}}{v\delta}\right)\right)$$

Fe-C-Mn: 0.94%Mn-0.57%C



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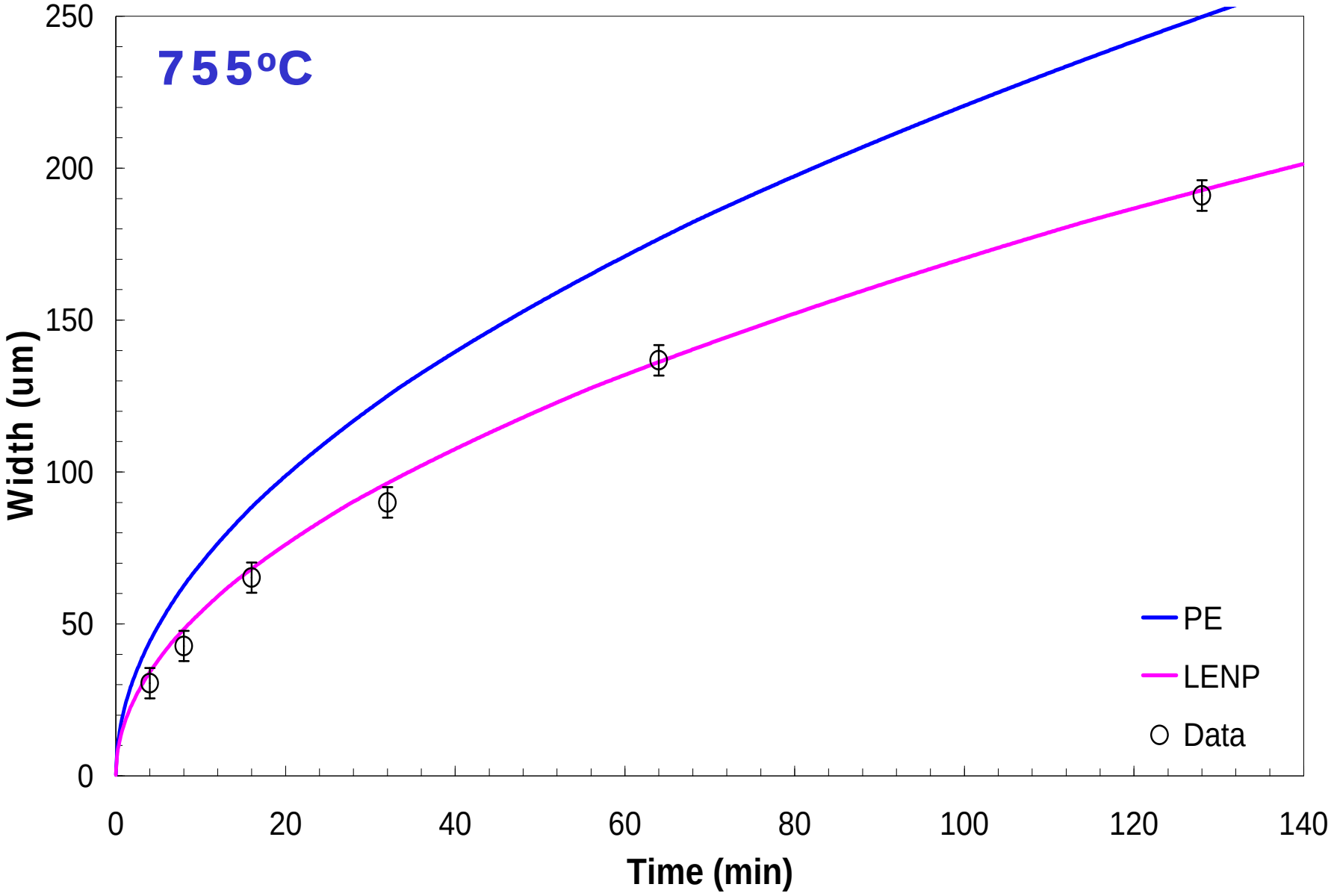

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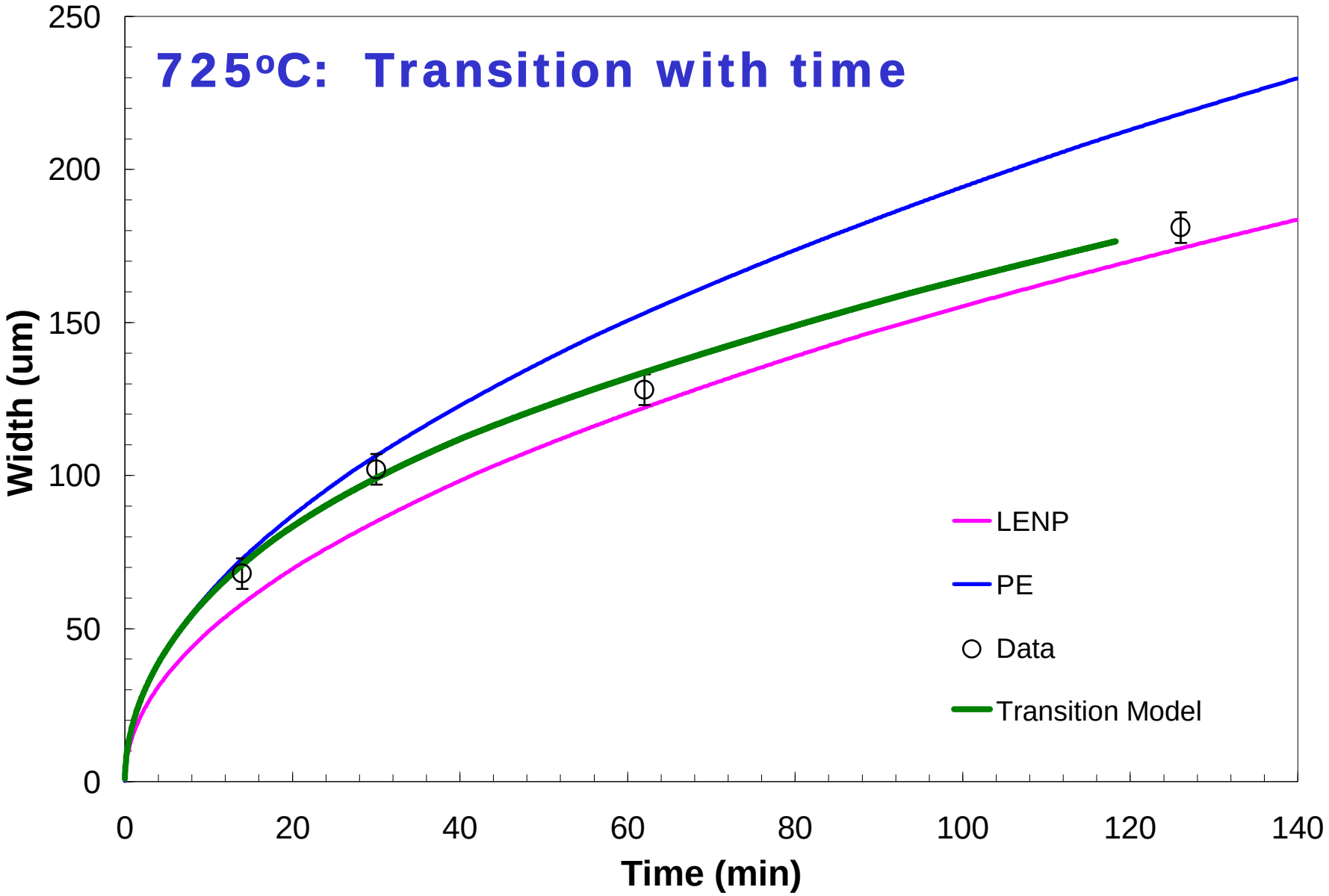

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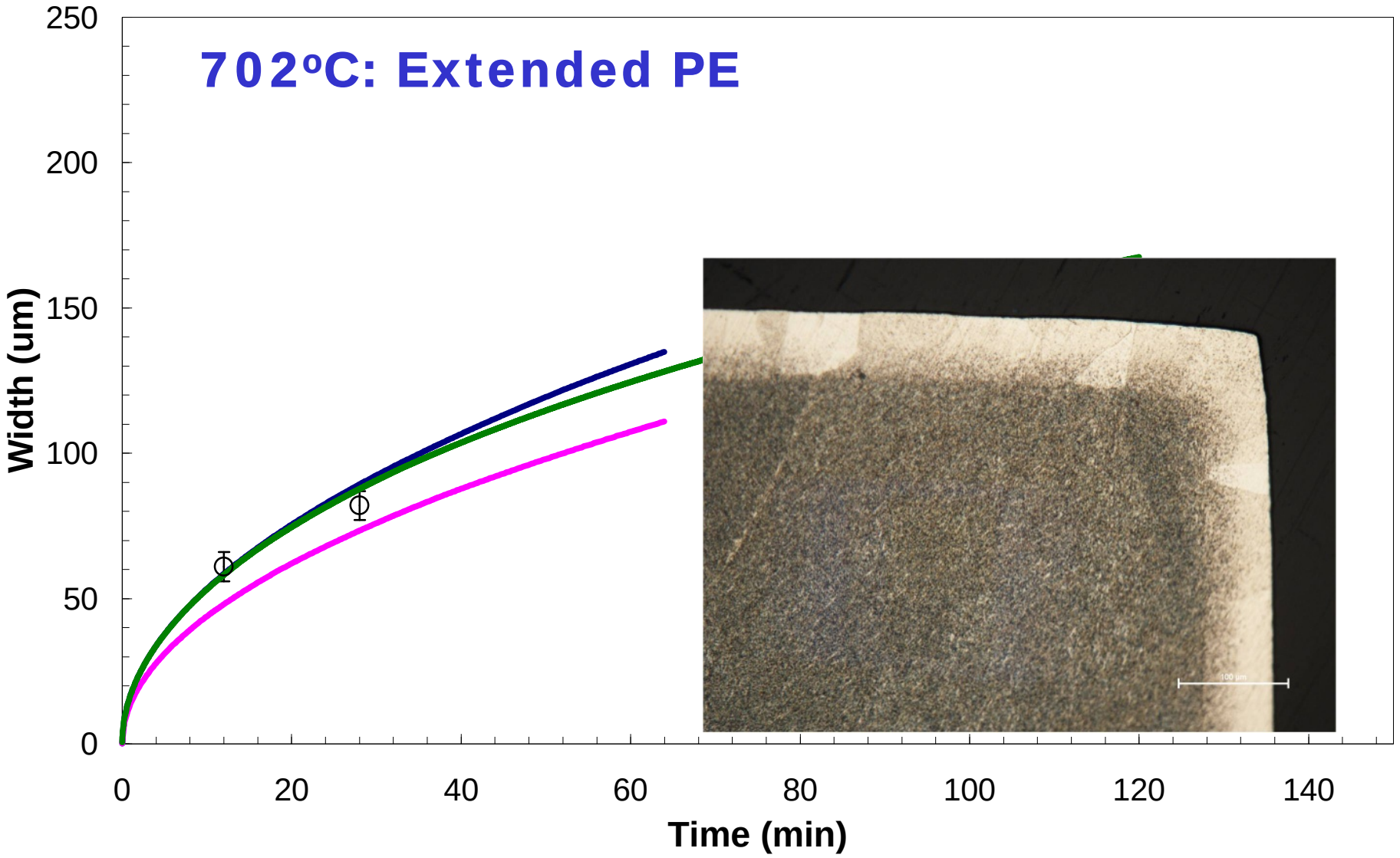


4. New Results on Fe-Mn-N.

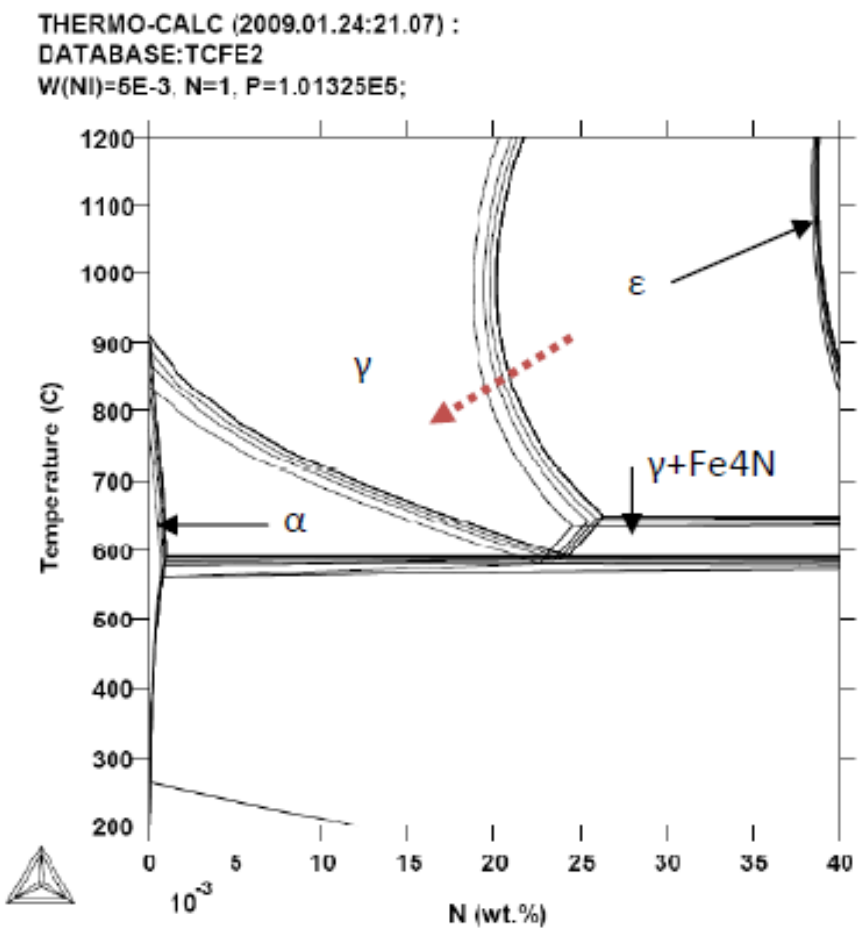


Figure 29 Fe-N diagram for different Ni concentrations (0, 0.5, 1 and 2 wt.%). The arrow show the direction of change when Ni is increasing.

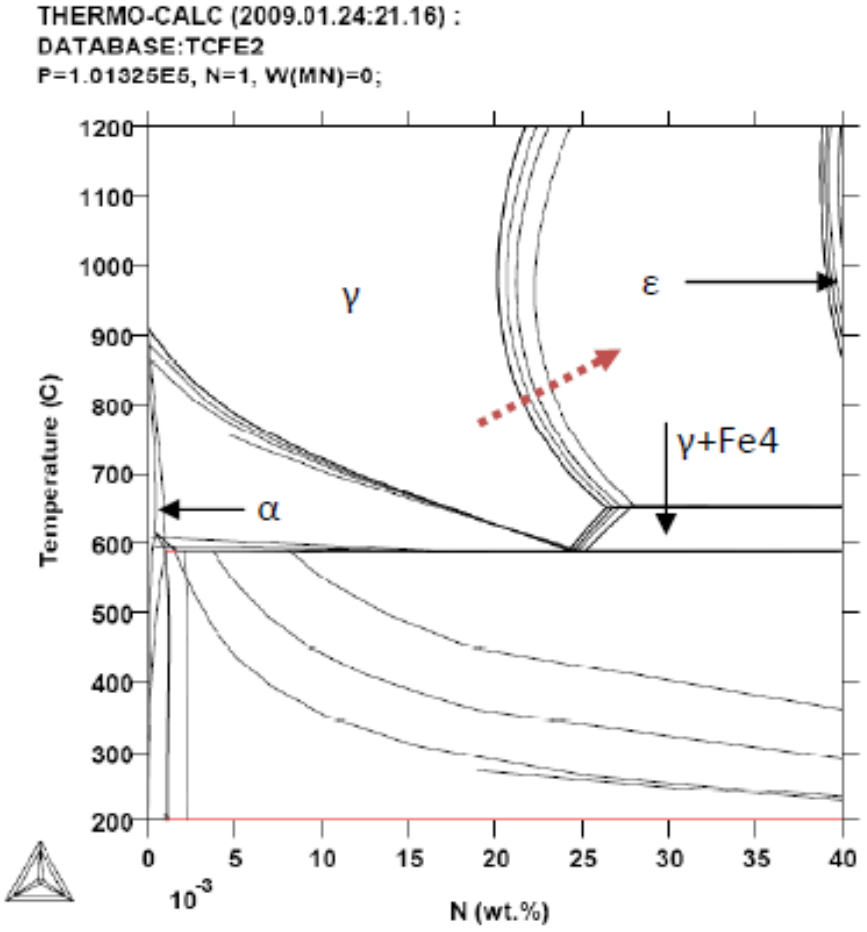
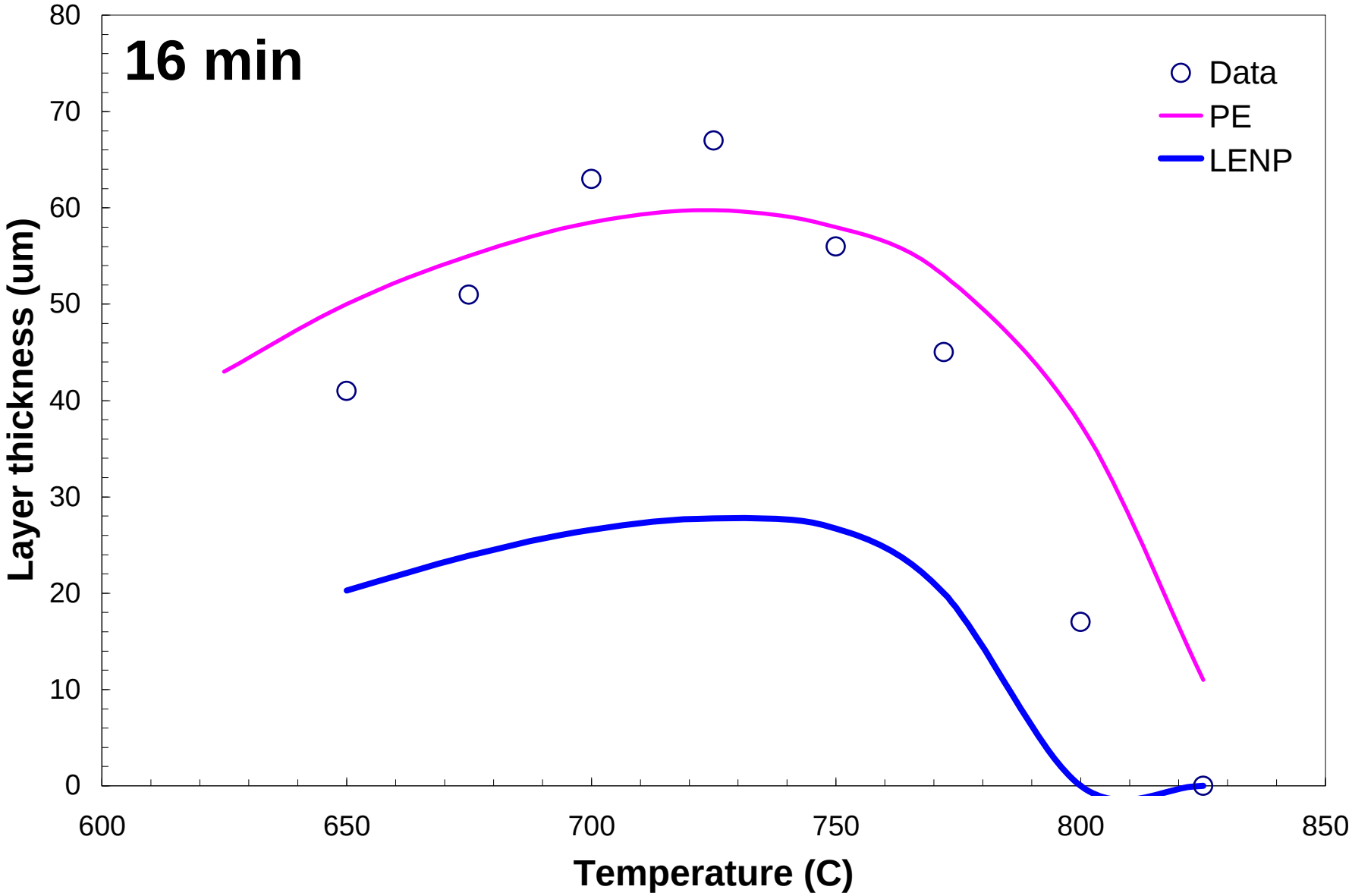
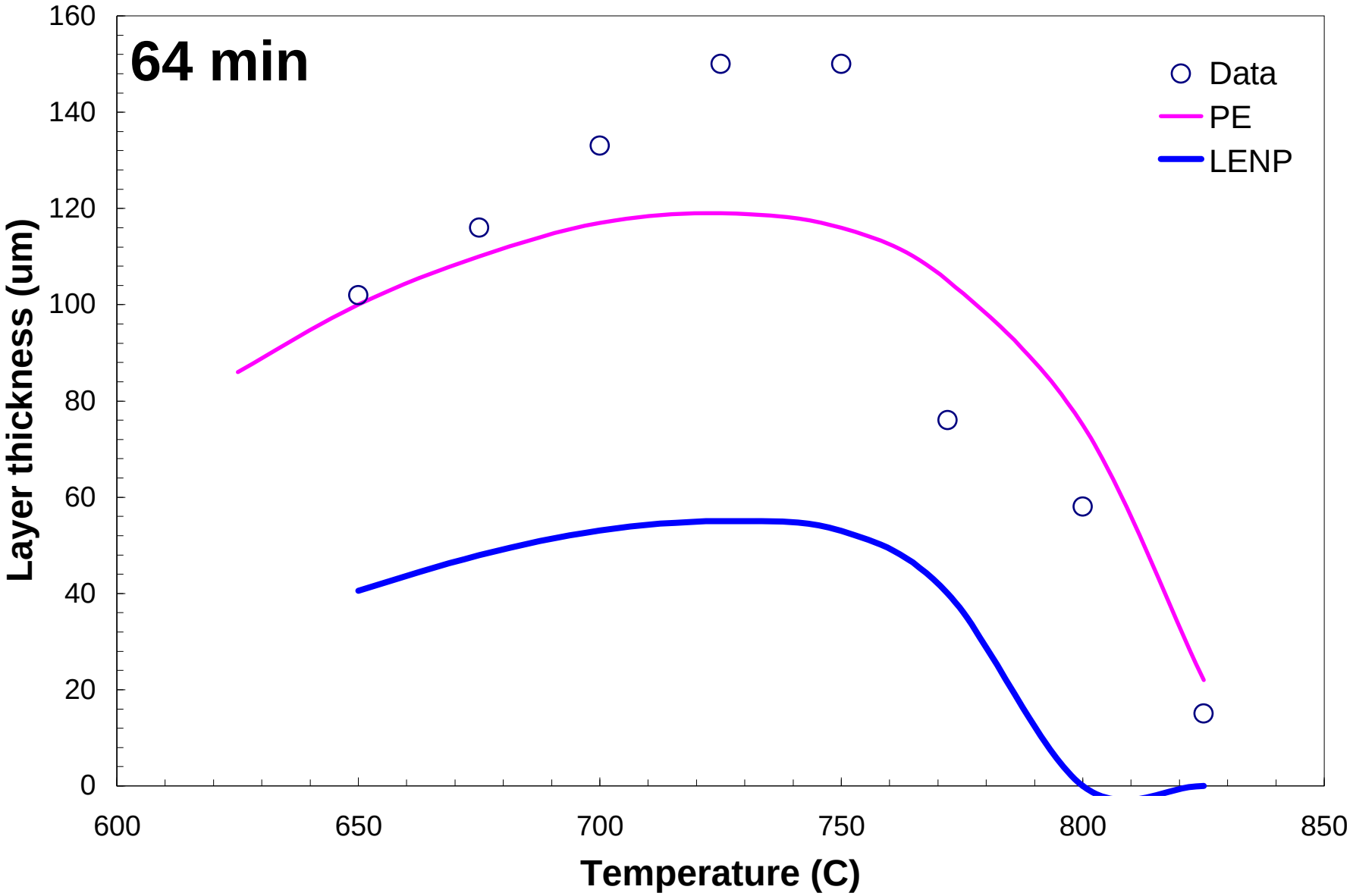


Figure 30 Fe-N diagram for different Mn concentrations (0, 0.5, 1 and 2 wt.%). The arrow show the direction of change when Mn is increasing.

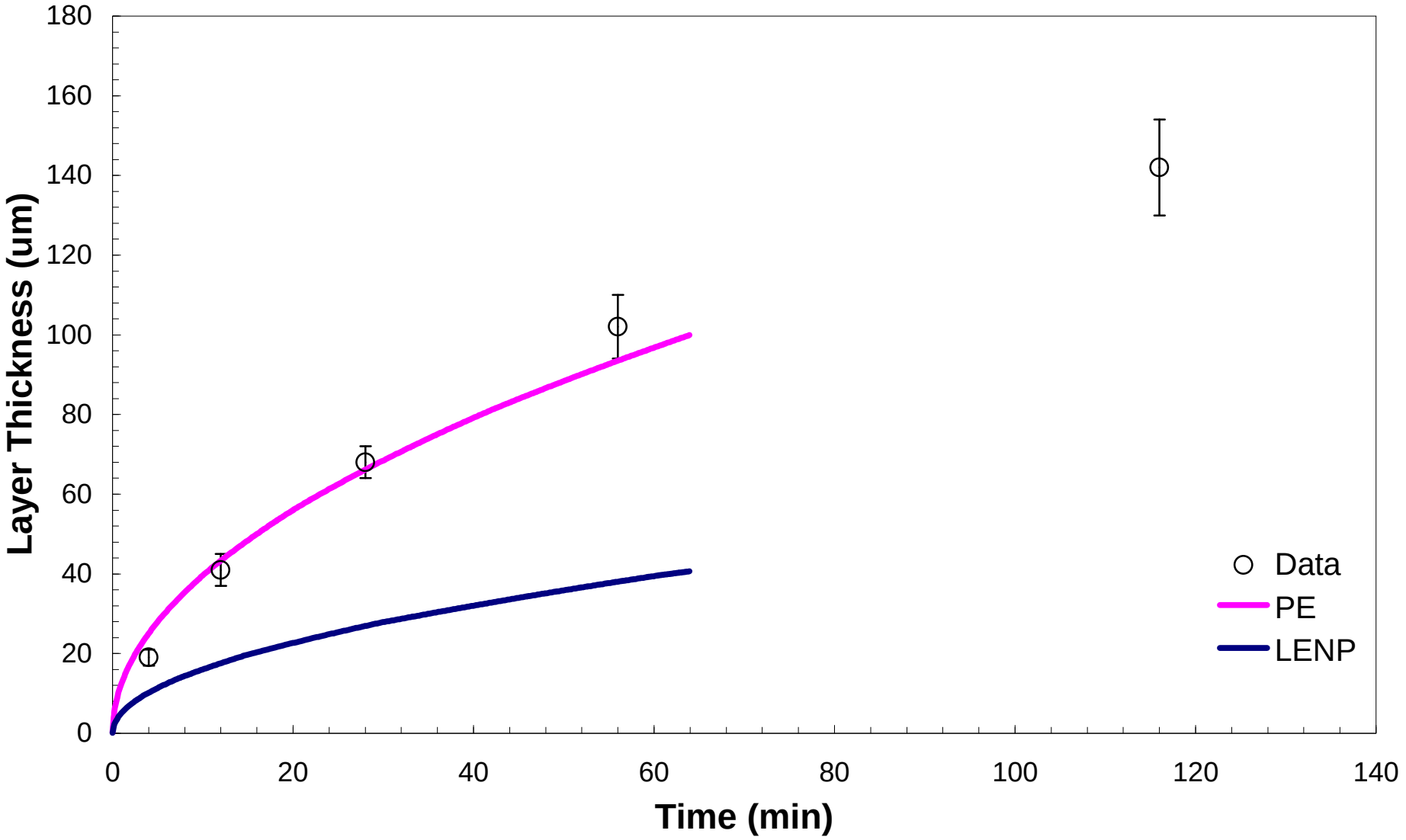
Denitriding of Fe-1.43%Mn-1.8%N



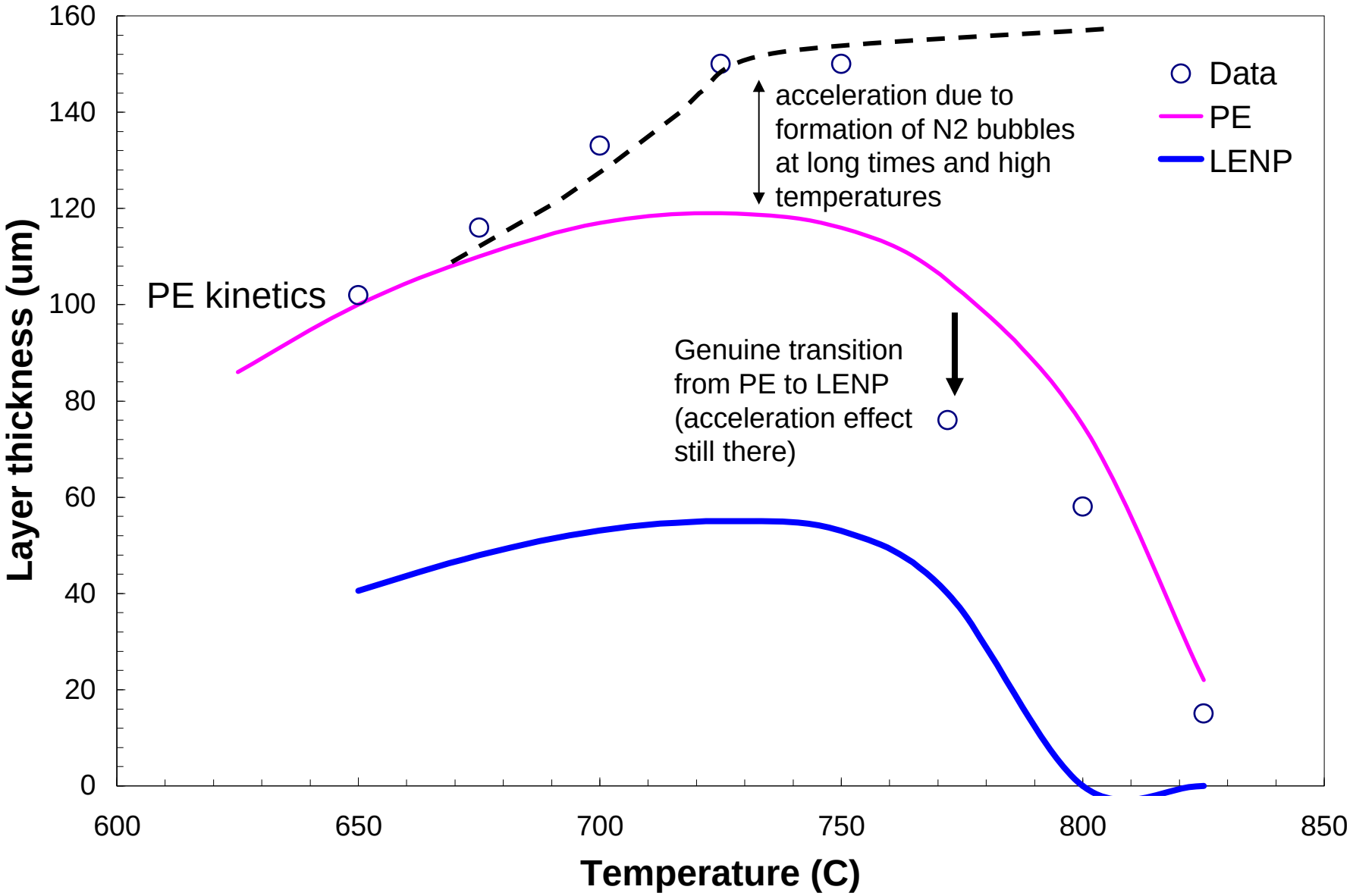
Denitriding of Fe-1.43%Mn-1.8%N



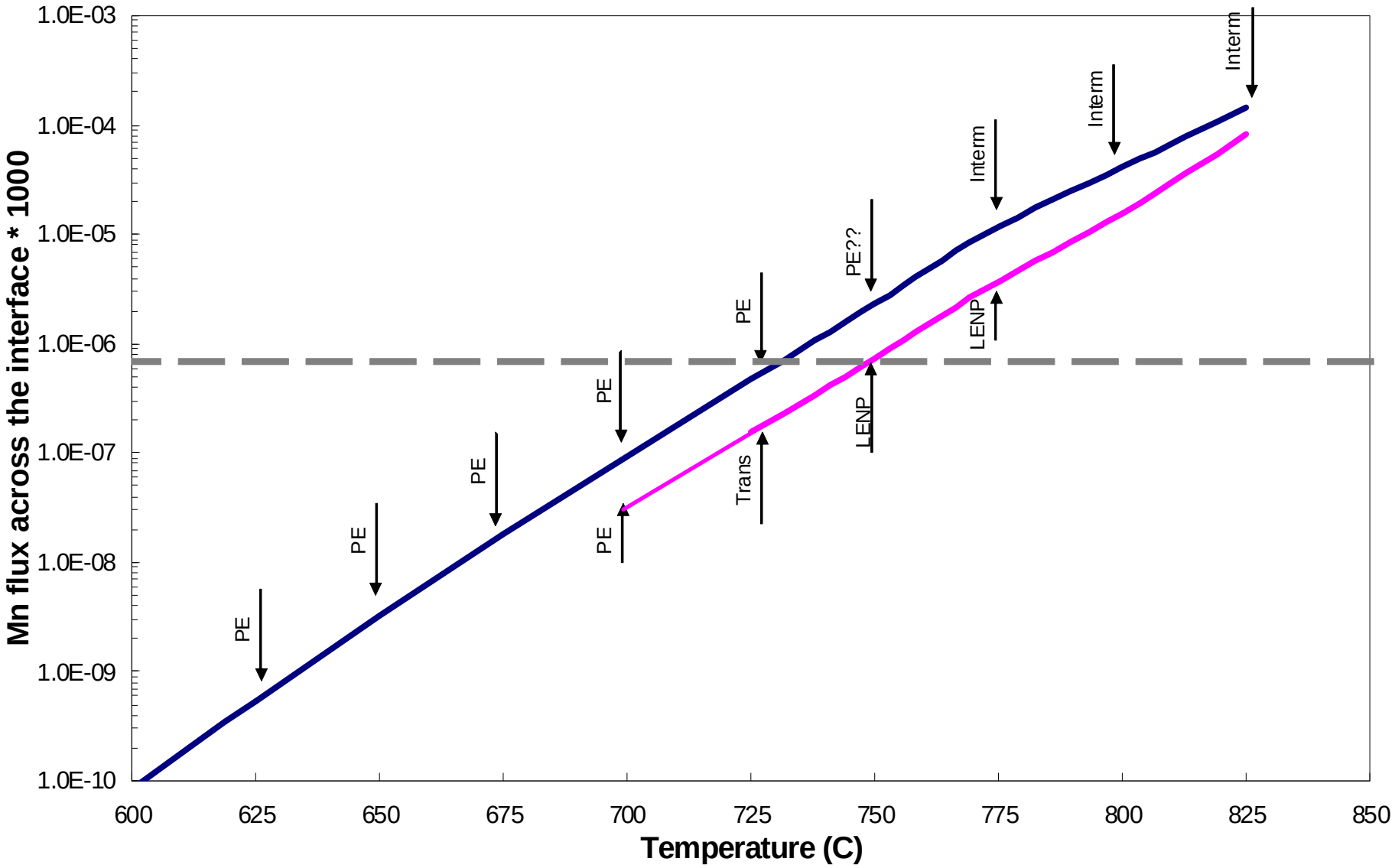
Isothermal denitrogenizing kinetics at 650C



Interpretation (64 Min data)



Denitriding of Fe-1.43%Mn-1.8%N
Decarburizing of Fe-0.94%Mn-0.57%C



Summary:

- Ferrite growth kinetics were accurately measured using the decarburization method.
- Kinetics transitions have been observed. These transitions suggest:
  - A range for the value of the cross-interface mobility of Mn.
  - A capacity for Mn in the migrating interface.