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On the formation of a β layer in $\gamma + \beta$ diffusion couples and diffusion paths with "horns"

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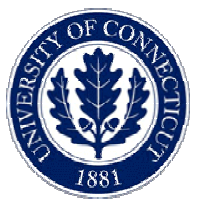
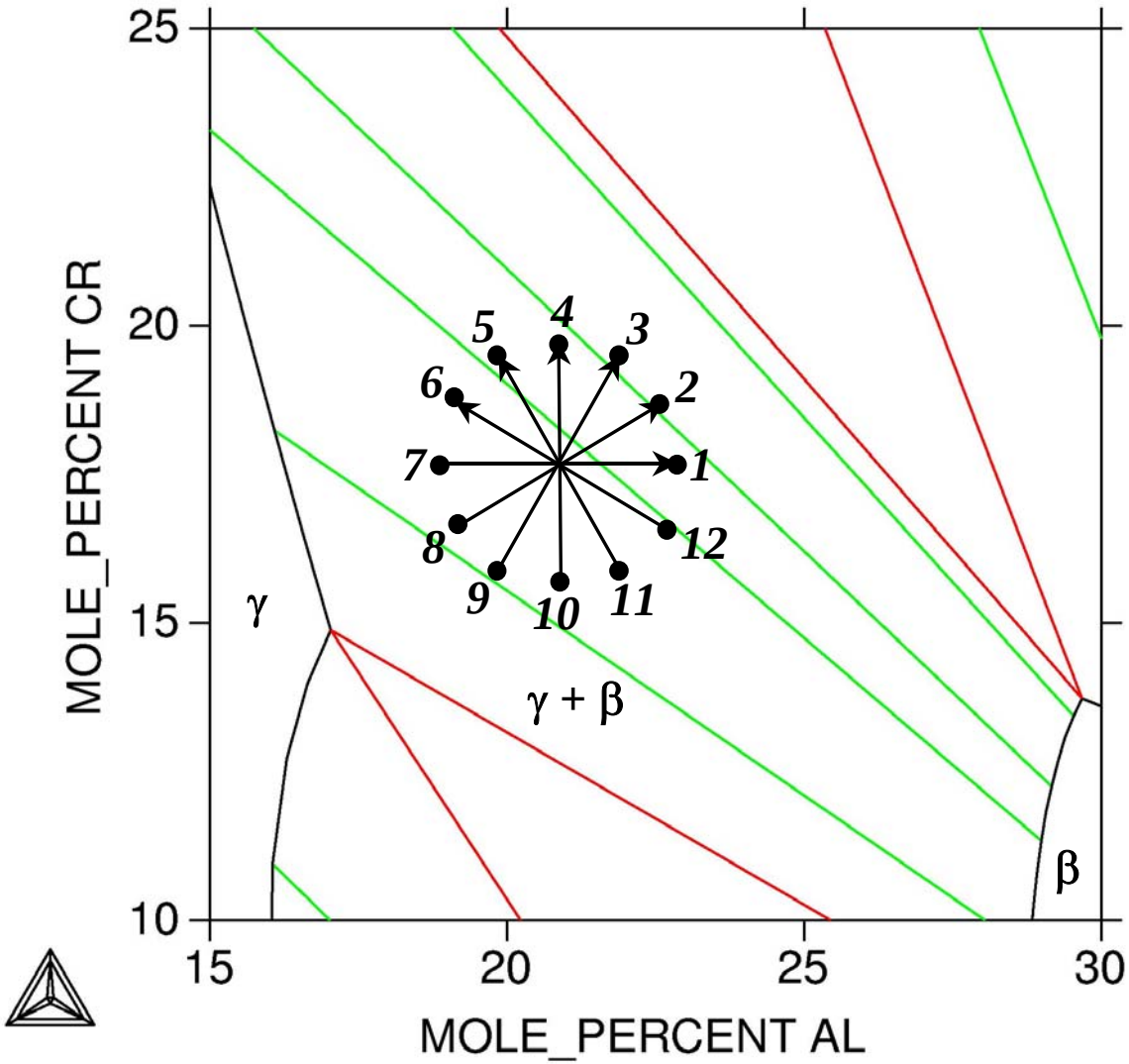


Outline

- **The experimental observation of a β layer in certain $\gamma + \beta$ diffusion couples**
- **Zigzag diffusion paths and the diffusion paths with "horn"**
- **The characterization of "horn"**
- **The transition between inward and outward "horns"**
- **The explanation of the β layer formation**

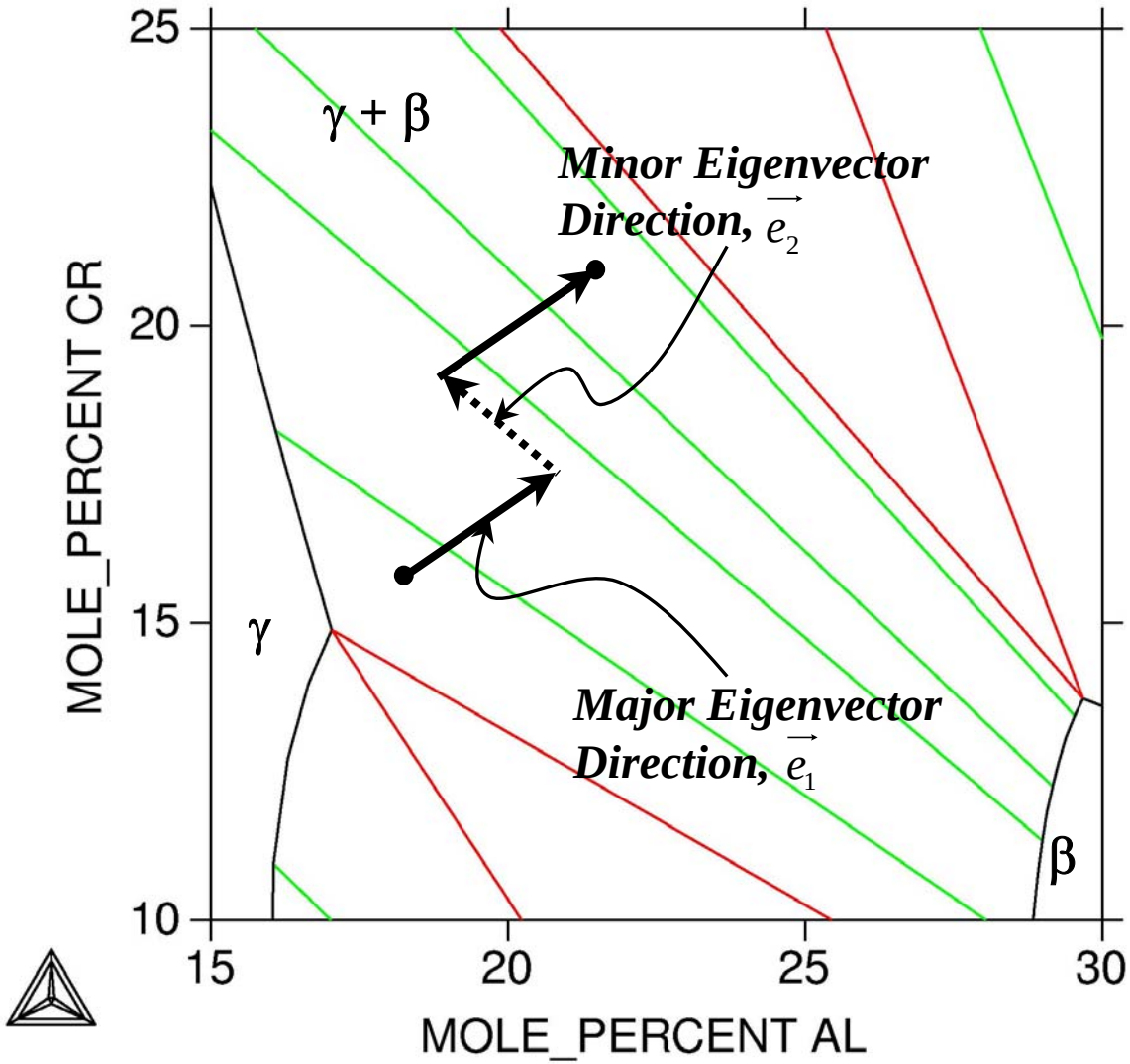
β layer in γ + β diffusion couples



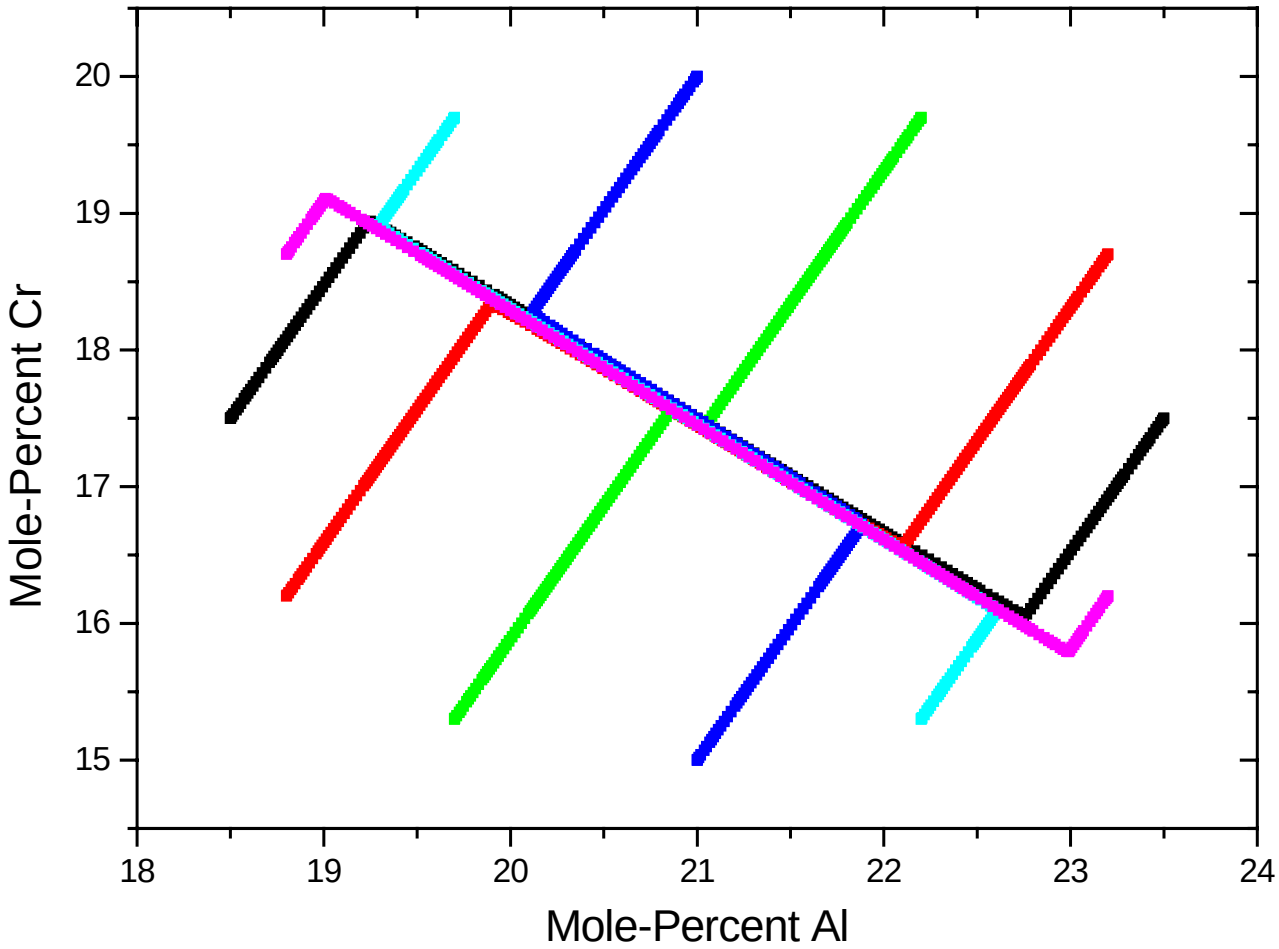
β layer in γ + β diffusion couples

β layer formed	NO β layer formed
$\gamma + \beta < \beta > \gamma + \beta$	$\gamma + \beta \,/\, \gamma + \beta$

Error function prediction

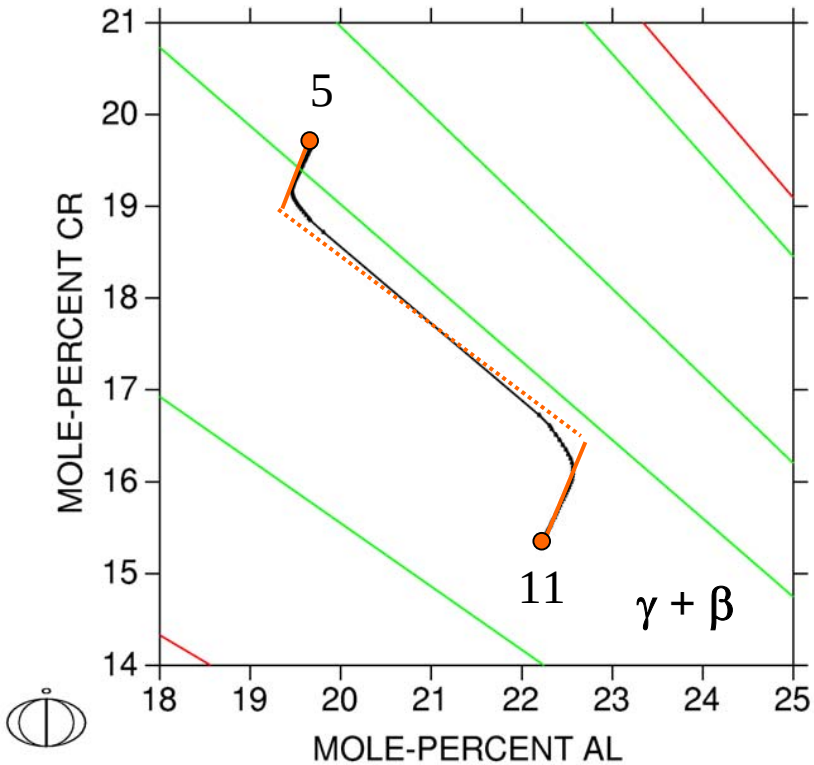


Zigzag diffusion paths of γ + β couples

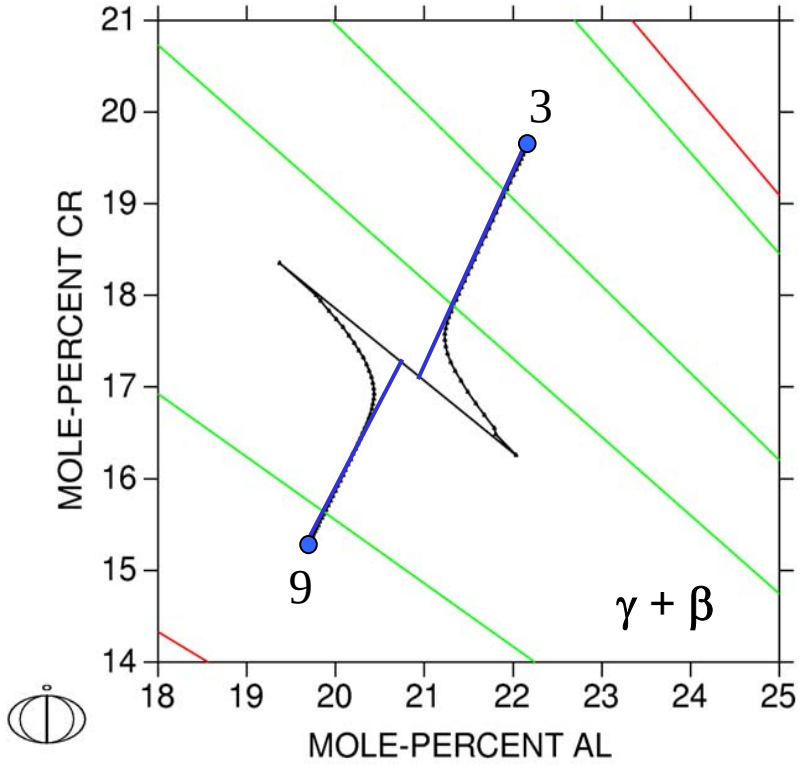


Diffusion paths with “horns”

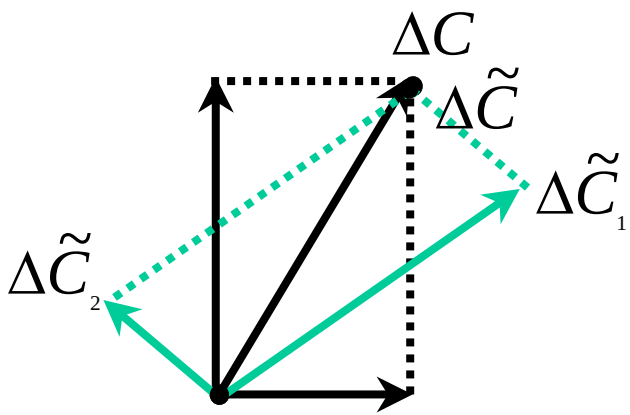
Horns Point Inward



Horns Point Outward



Characterization of “horns”

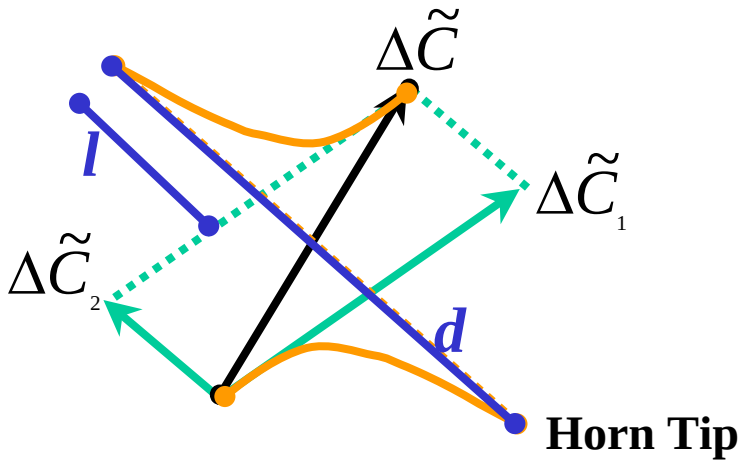


$$[\tilde{D}^{eff}] = [\alpha][D^{eff}][\alpha^{-1}]$$

$$[\Delta\tilde{C}) = [\alpha][\Delta C)$$

$$\begin{bmatrix} \Delta\tilde{C}_1 \\ \Delta\tilde{C}_2 \end{bmatrix} = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \end{bmatrix} \begin{bmatrix} \Delta C_1 \\ \Delta C_2 \end{bmatrix}$$

Characterization of “horns”

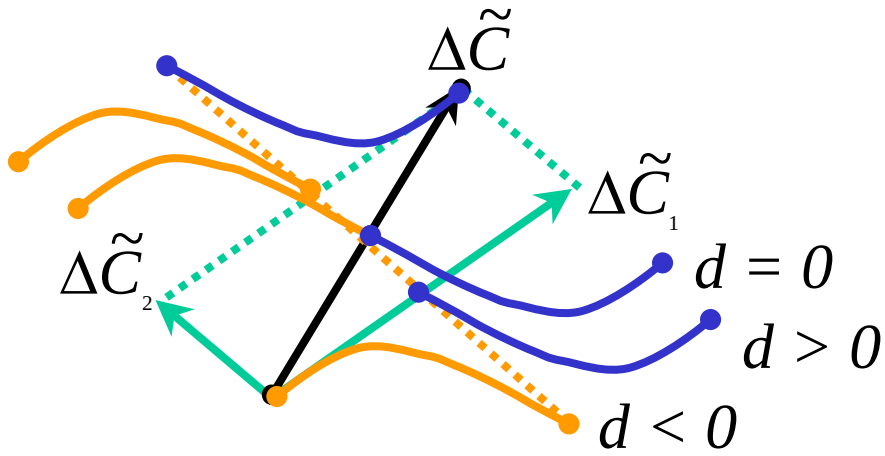


$$2l = \left|\Delta\tilde{C}_2 - d(\Delta\tilde{C}_1, \Delta\tilde{C}_2)\right|$$

d = The distance between horn tips

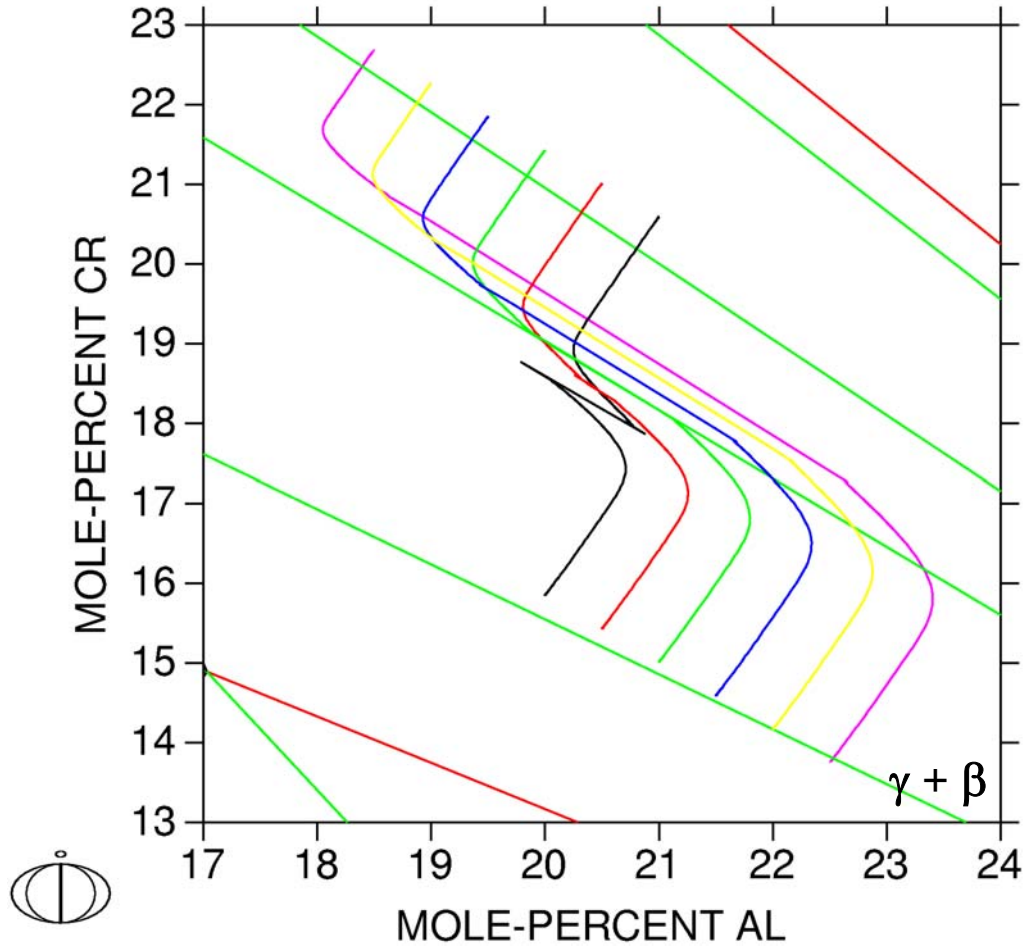
l = The horn length

Characterization of “horns”

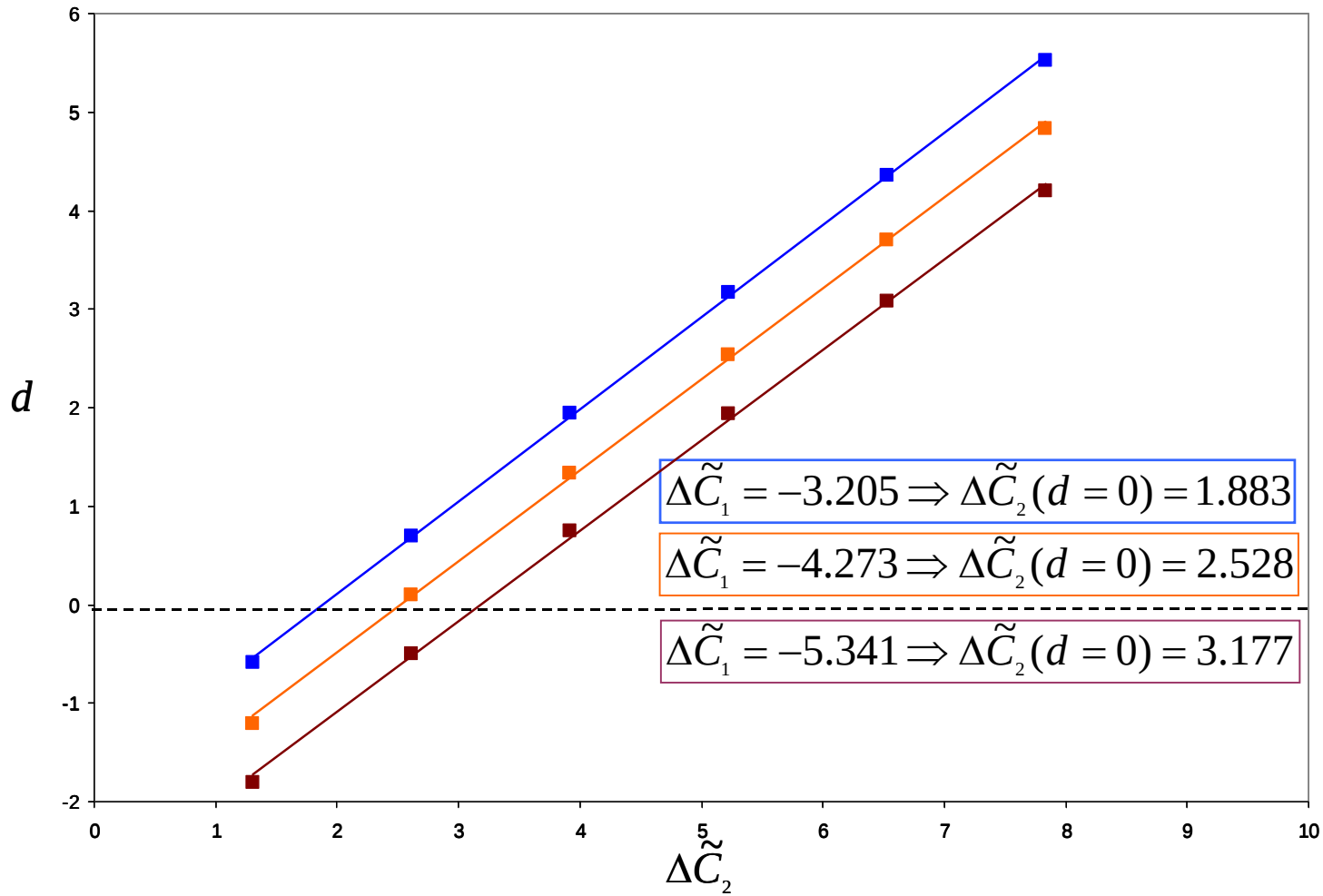


“Horn” change with compositions

$$\Delta\tilde{C}_1 = -4.27$$

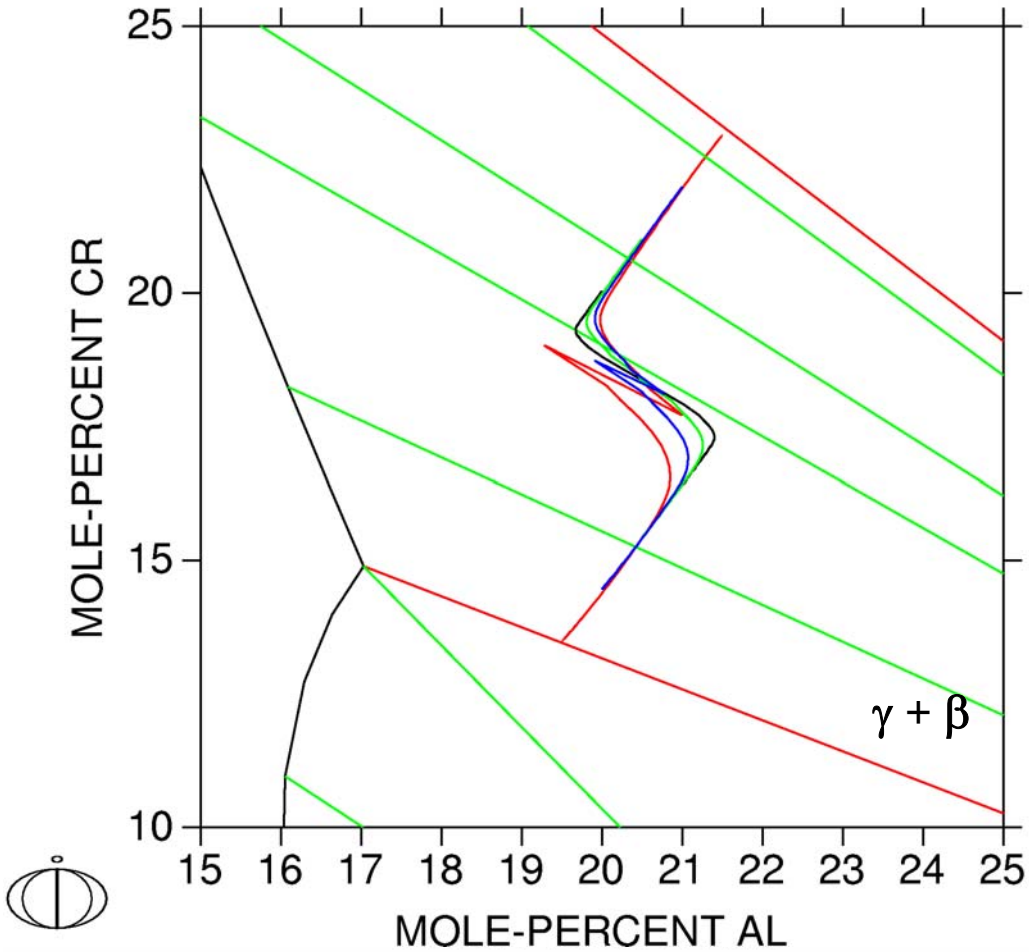


“Horn” change with compositions

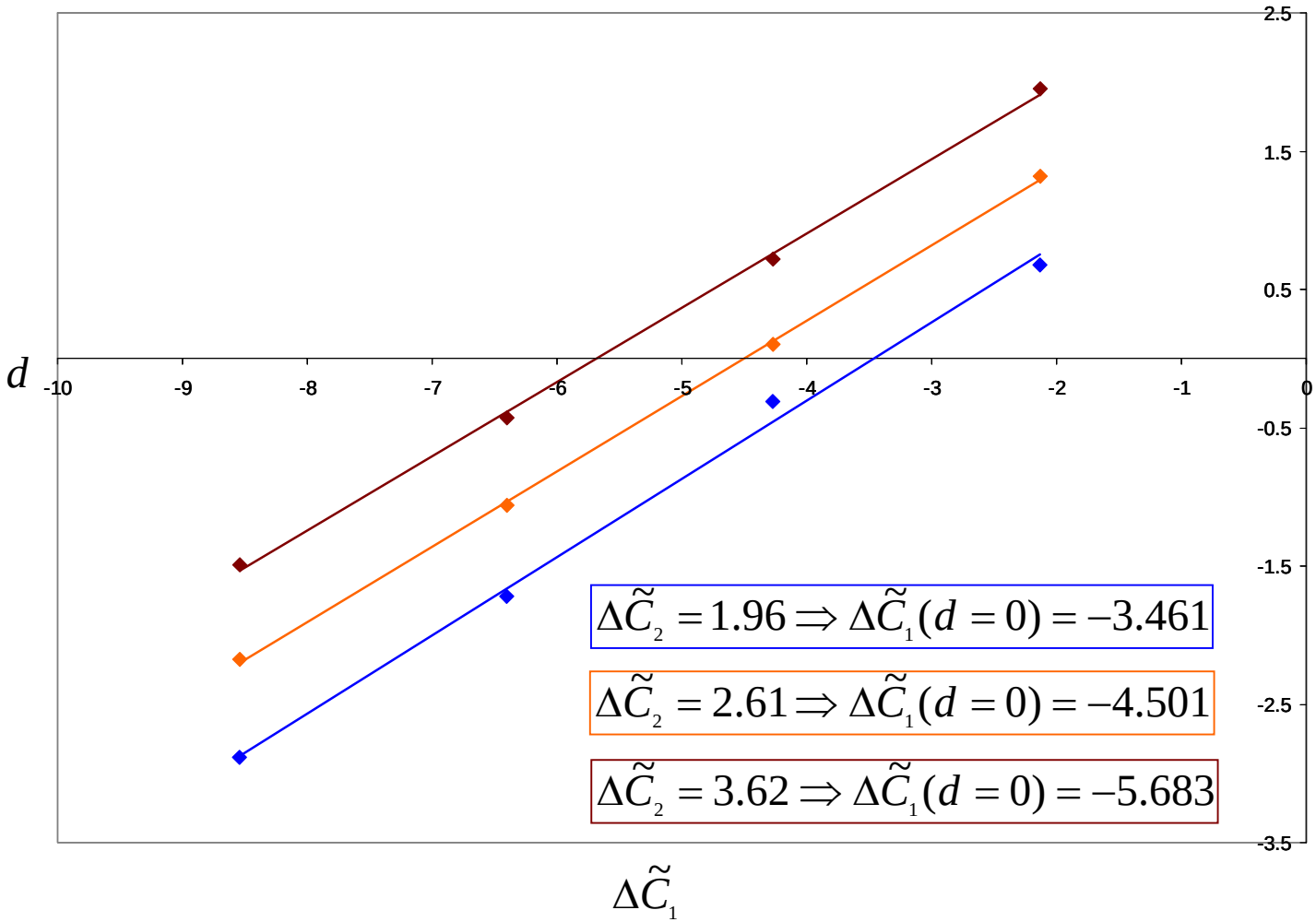


“Horn” change with compositions

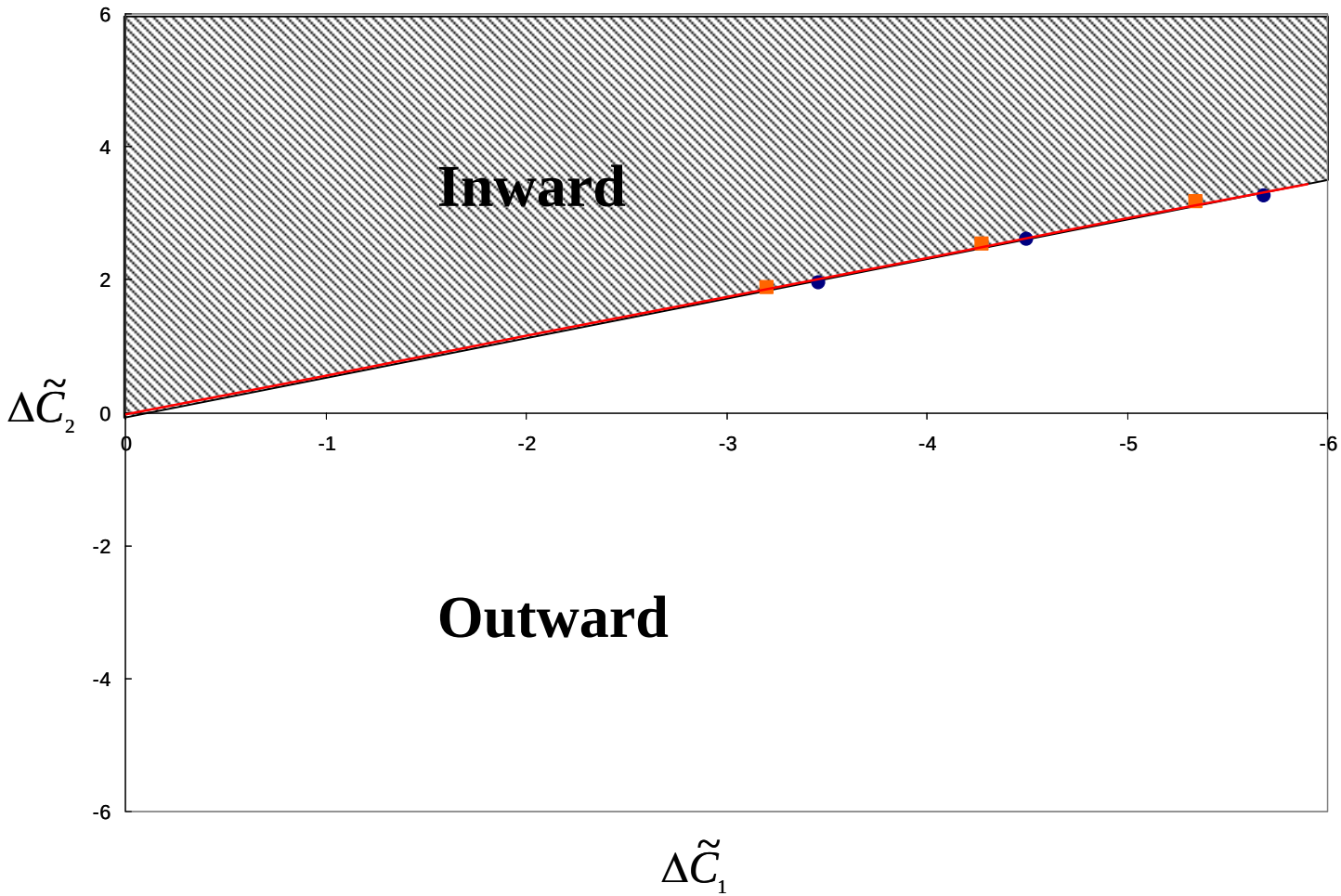
$$\Delta\tilde{C}_2 = -2.61$$



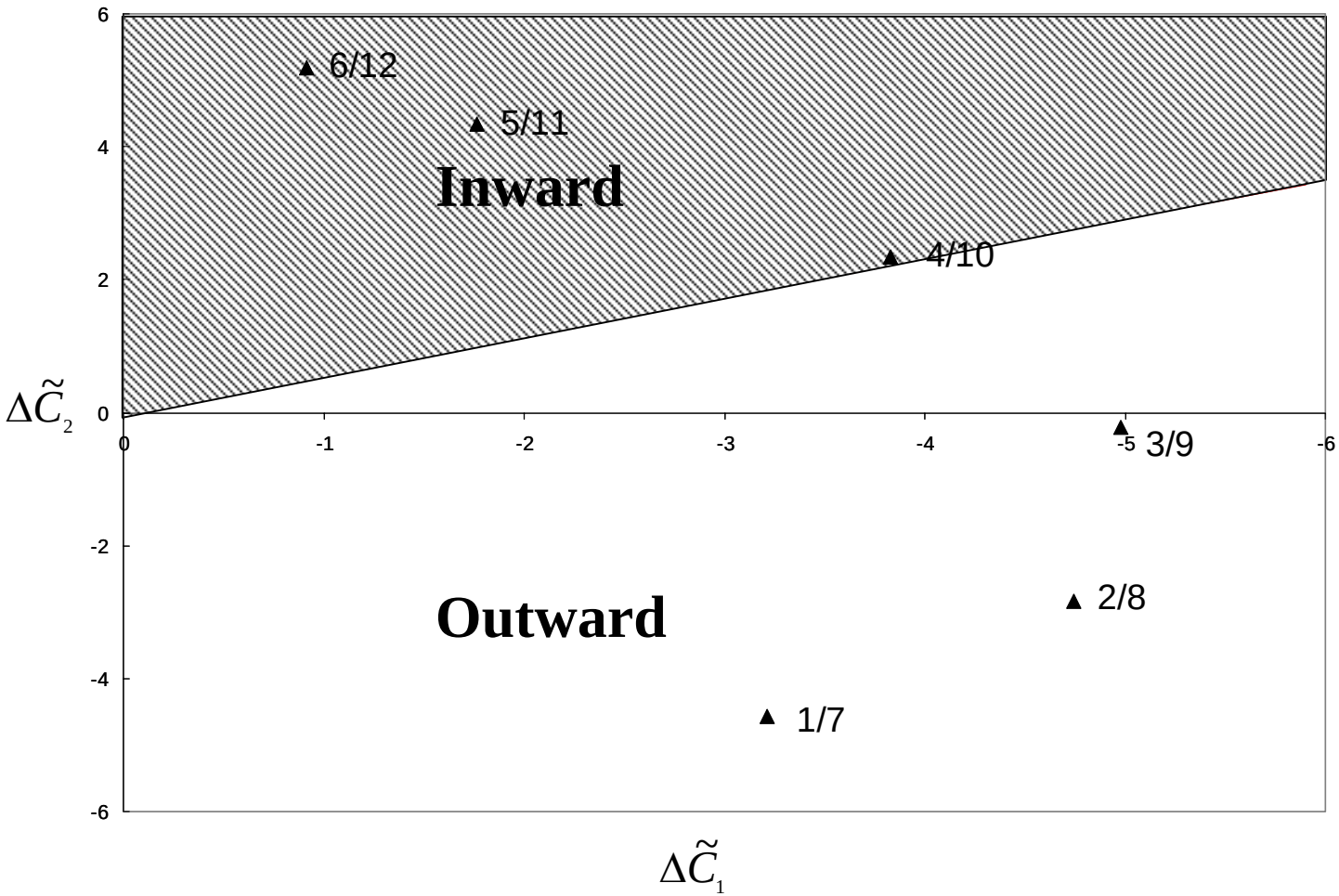
“Horn” change with compositions



Transition between inward and outward horns



The formation of β layer



Summary

- **DICTRA simulations of γ+β diffusion couples show sharp deviations from linear zigzag paths, appearing as inward or outward pointing horns.**
- **The transition between inward and outward "horns" is related to the change in composition.**
- **The formation of a β layer in experimental γ + β diffusion couples is associated with predicted diffusion paths containing outward horns.**