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# Study of partitioning kinetics of alloying elements in a medium Mn steel during Q&P treatments using phase field modelling

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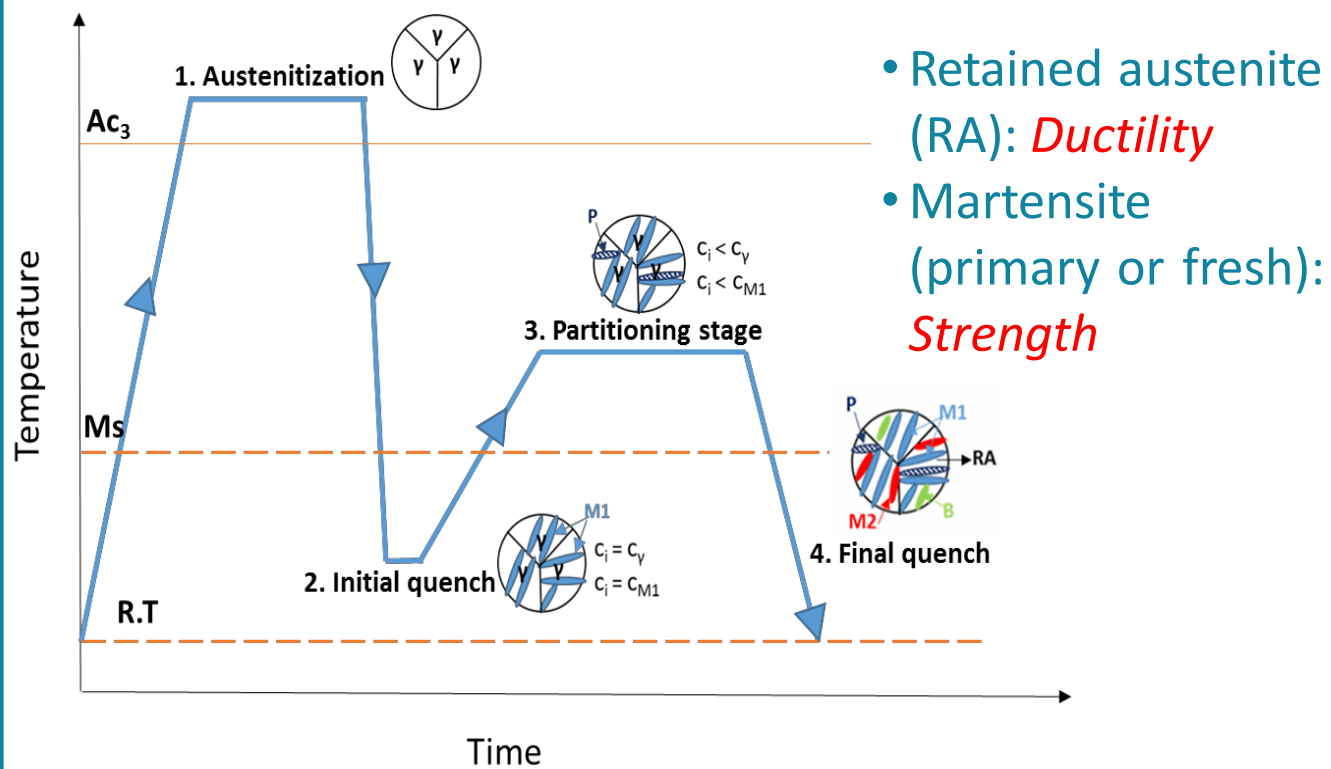
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## Background

### Development:

AHSS in automotive parts to accomplish resource efficiency, high strength and less weight.

### Q&P steels:



- Retained austenite (RA): **Ductility**
- Martensite (primary or fresh): **Strength**

- Partitioning of alloying elements from martensite ( $\alpha'$ ) to austenite ( $\gamma$ ) and stabilization of austenite is crucial for Q&P process.
- So far carbon, an interstitial alloying element, is considered as the main austenite stabilizer in the Q&P process.
- Manganese and Nickel are also strong austenite stabilizers.

## Objective

- To develop a model using phase field modelling for the study of the partitioning of interstitial and substitutional alloying elements (Mn, Si and Ni) during the quenching and partitioning process.

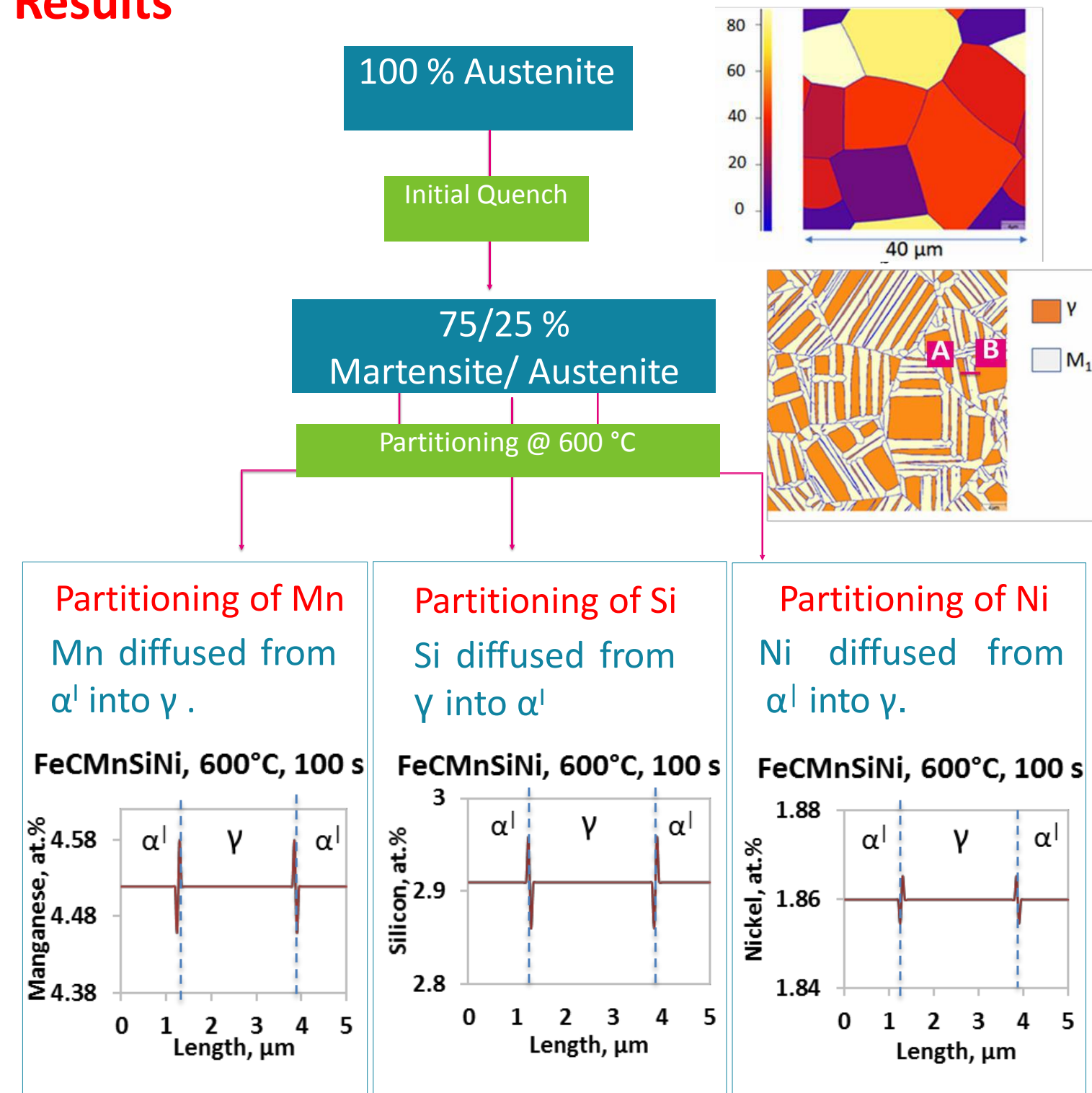
## Approach

- Study different alloying systems: *FeCMn*, *FeCMnSi*, *FeCSiNi*, *FeCMnSiNi*, *FeCMnNi*.

Element	C	Mn	Si	Ni	Fe
Conc., (at. %)	1.38	4.58	2.91	1.86	89.27

- Partitioning conditions : 400, 500 and 600 °C : upto 500 s

## Results



No.	Alloy	Time at which partitioning starts to be detected (s)		
		Mn	Si	Ni
1	FeCMn	40	-	-
2	FeCMnNi	40	-	50
3	FeCMnSiNi	70	40	90
4	FeCMnSi	125	90	-
5	FeCSiNi	-	125	>500

## Discussion

- Partitioning of substitutionals is detected only at 600 °C.
- With the addition of Si a delay in Mn diffusion is observed (1-4) / (2-3).
- Addition of Ni promoted Mn diffusion in the presence of Si (3 - 4).
- In the absence of Mn, the diffusion of Si and Ni is delayed by long time (5).

## Conclusions

Partitioning kinetics of alloying elements (Mn, Si and Ni) during the quenching and partitioning process is studied successfully. It was observed that a mutual impact on the partitioning of alloying elements is observed depending on the alloy systems.

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