Refractoriness, microstructures and high temperature oxidation of TaC-reinforced iron-based alloys protected by chromium-rich coatings

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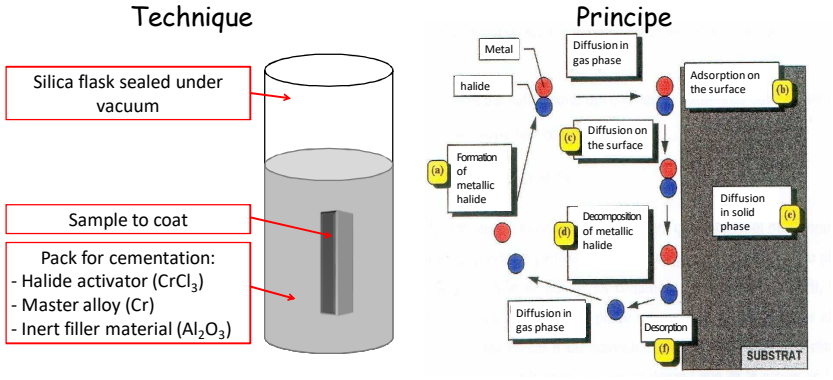
Introduction

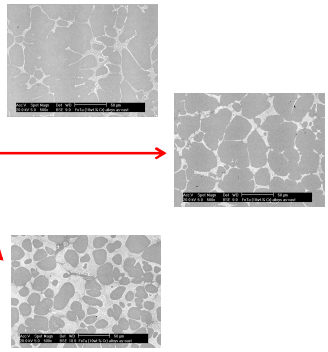
- Ferritic Fe-based alloys: good refractoriness but low creep resistance
- Oxidation resistance: can be given by sufficient Cr content
- Unfortunately, Cr tends to decrease solidus temperature
- Obtaining simultaneously high refractoriness and efficient oxidation resistance: enrichment in chromium of the alloy surface by pack-cementation

Pack-cementation



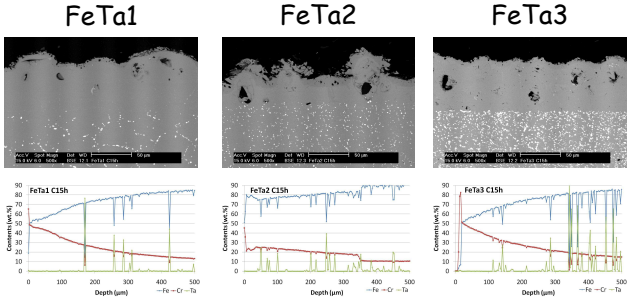
Compositions and microstructure

	Fe	Cr	Ta	C
FeTa1	Bal.	10.0	3.0	0.2
FeTa2		10.0	3.0	0.4
FeTa3		10.0	6.0	0.4



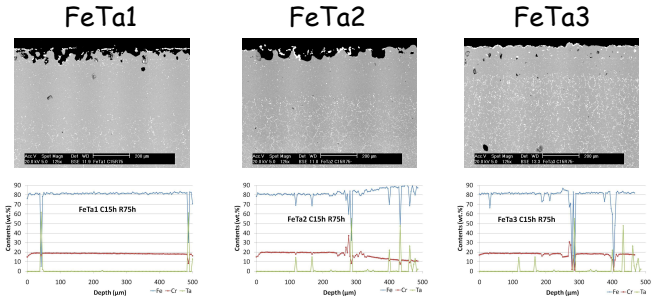
Fe-based alloys reinforced by TaC carbides

Cementation: 15h at 1050°C



Enrichment of the sub-surface in chromium (50wt.%) over depths of about 350-500 µm

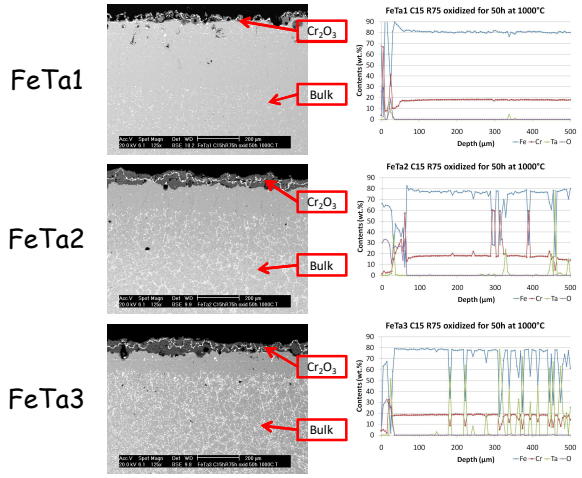
Cementation: 15h at 1050°C and diffusion treatment: 75h at 1200°C



Coated alloys	FeTa1	FeTa2	FeTa3
Cr-content on the surface (%weight)	18.8 (±0.3)	19.7 (±0.1)	18.9 (±0.3)
Enriched depth (µm)	> 500	270	> 500

diffusion treatment:
- FeTa1 et FeTa3: Cr-enrichment of the sub-surface (~20 wt.%) over more than 500 µm
- FeTa2: Cr-enrichment over more than 500 µm (almost constant equal to ~20 wt.% over the first 270 µm)

Resistance to oxidation at 1000°C for 50h (Furnace)



Coated alloys : good resistance against oxidation / alloys without coating

Conclusions

Cementation:
- Good enrichment on the surface: 20% mass in chromium
- Enrichment-depth depends on carbon and on tantalum contents

Resistance to oxidation:
- Correct resistance for all coated alloys
- Equivalent to alloys with 30% in chromium