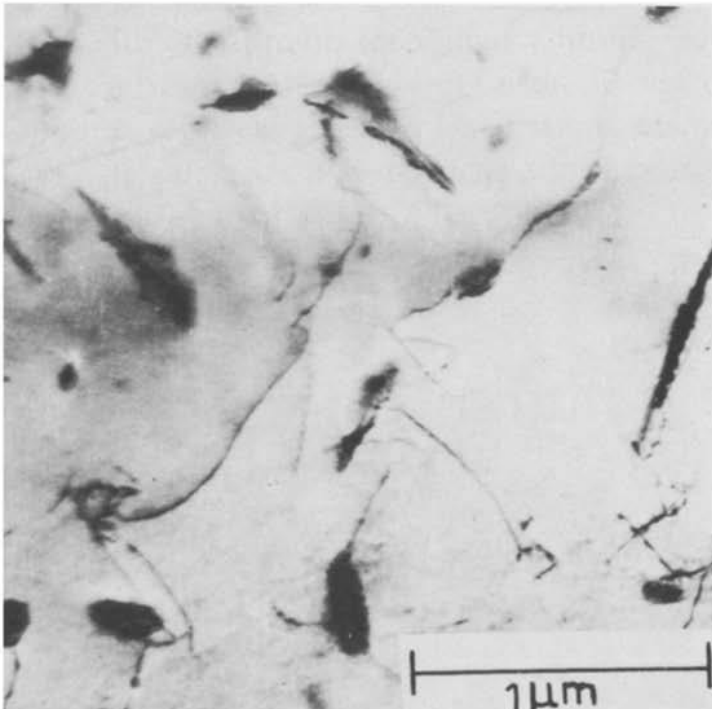


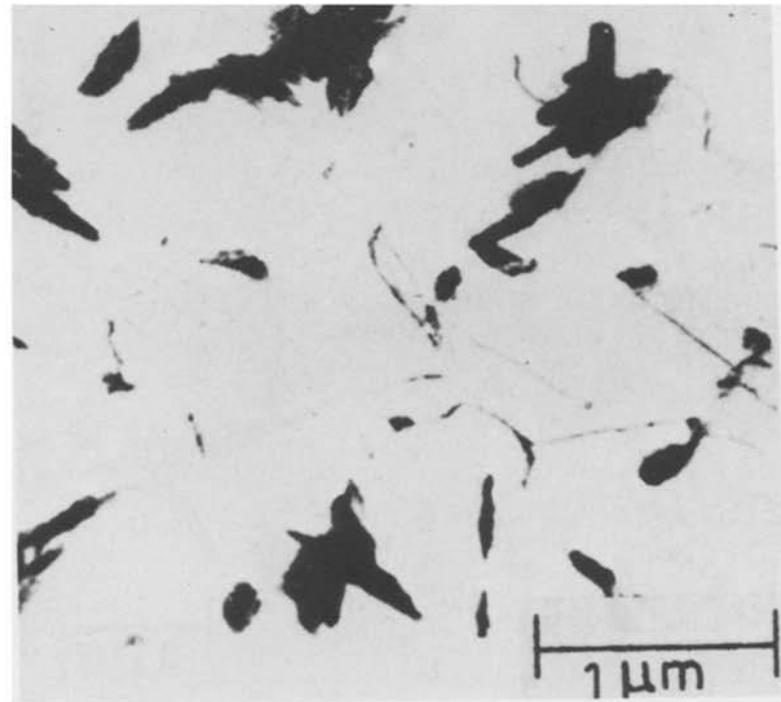


On the magnetic ageing of steel

Ageing occurs during the service life of steels and it manifests itself as a continuous decrease of magnetic properties, namely as an increase of core-loss (or increased coercivity), especially at higher temperatures. It is associated with microstructural changes caused by carbon inclusions precipitating as carbides (cementite) which pin interact with and the domain walls, causing “ageing”. Therefore steels with low carbon content are generally used: for the LHC MSI and MSD the typical carbon content is below 0.15%.

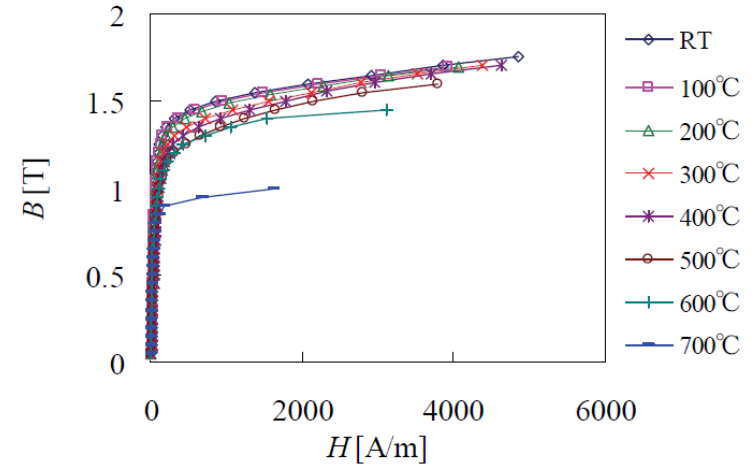
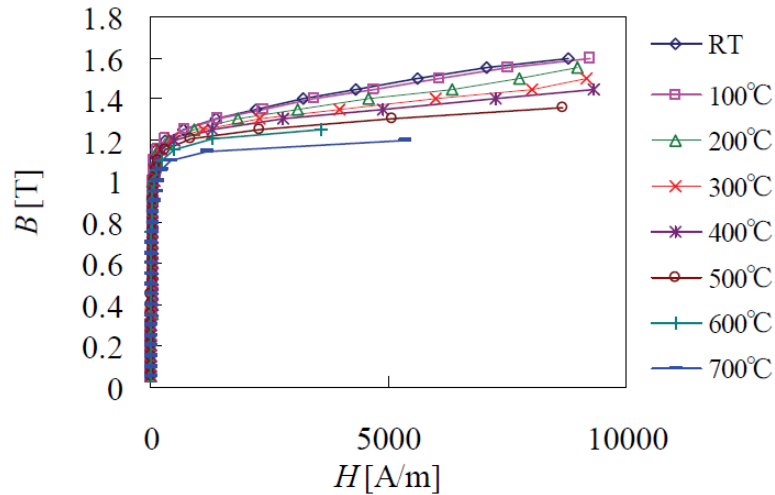


Cementite precipitates in 1.1% Si steel, aged 9×10^4 min at 175°C



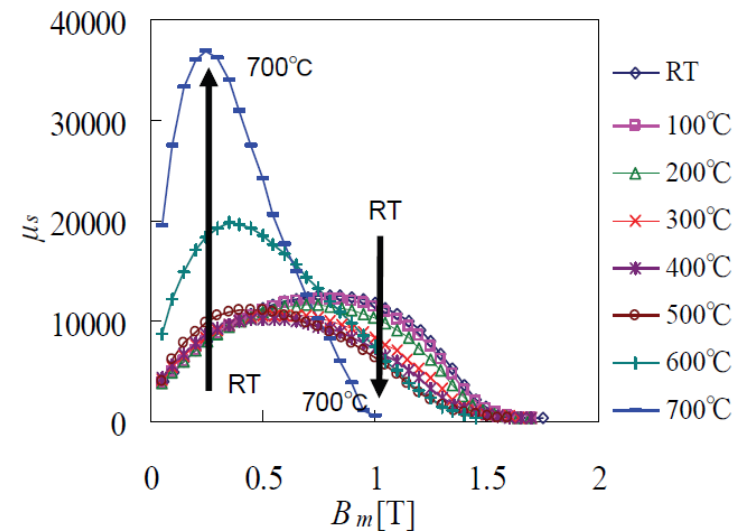
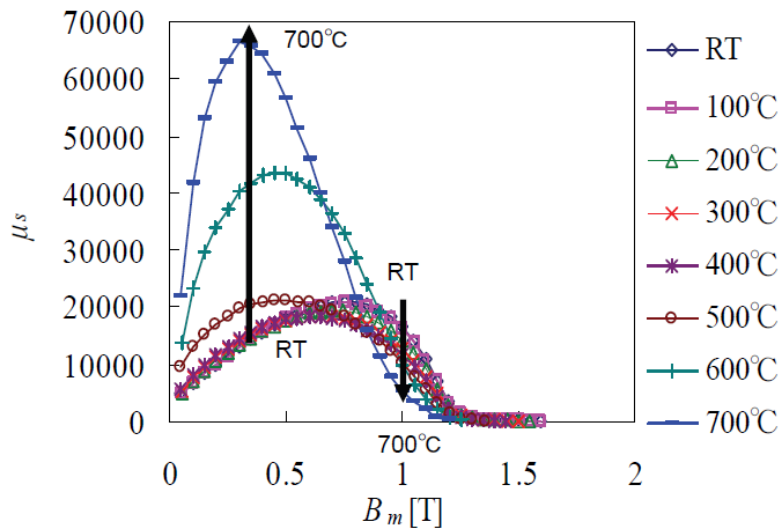
Large cementite precipitates in 1.1% Si steel, aged 10^4 min at 250°C [1]

Morishita et al. have done an extensive examination of several types of steels at temperatures just below the Curie point [2]



(c) 6.5% Si steel

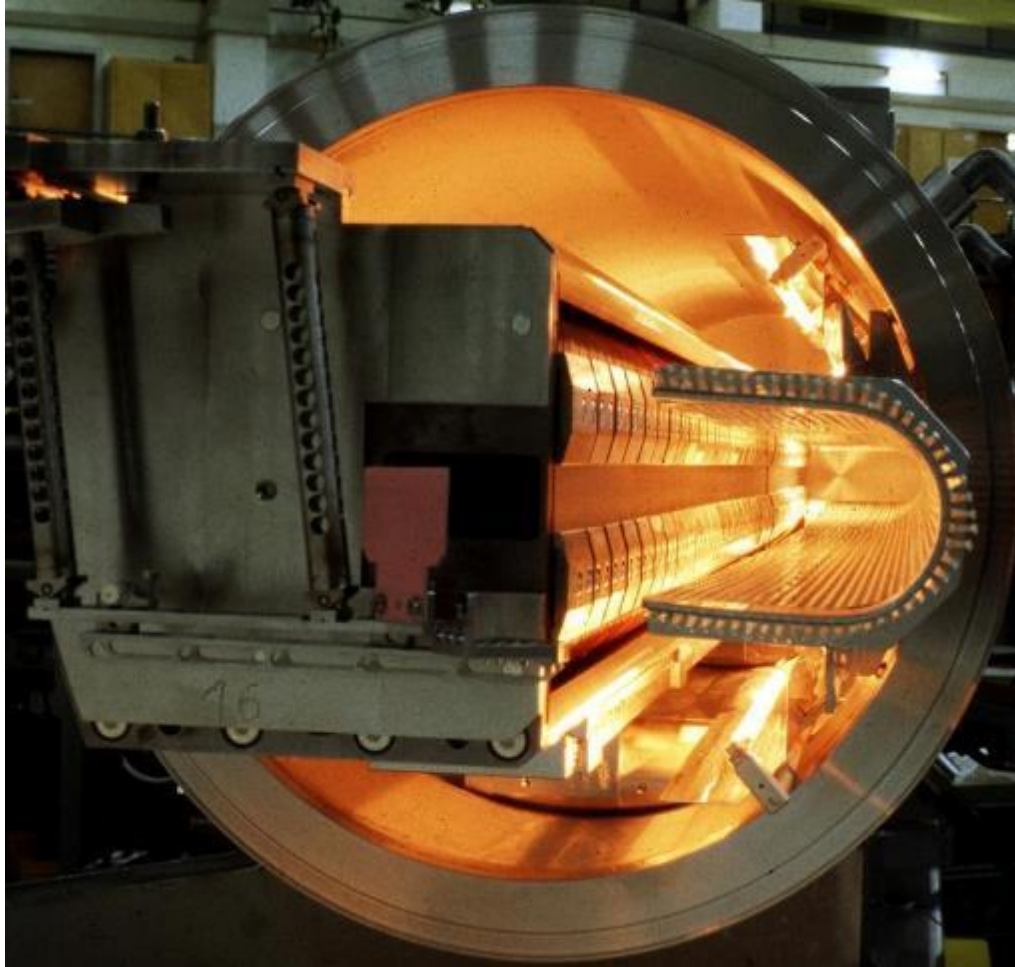
(d) 35A250



(c) 6.5% Si steel

(d) 35A250

Under vacuum septa



Septa installed under vacuum are regularly subjected to bakeouts at 200 °C for at least 24h. The temperature profile however is quite different, namely the temperature is gradually increased and decreased as a function of the vacuum levels.

No deterioration of magnetic performance has been observed so far.

References

- [1] O. N. Mohanty, On Predicting the Extent of Magnetic Ageing in Electrical Steels, Journal of Magnetism and Magnetic Materials 78 (1989) 255-262
- [2] M. Morishita, N. Takahashi, D. Miyagi, M. Nakano, Examination of Magnetic Properties of Several Magnetic Materials at High Temperatures, Electrical Review, ISSN 0033-2097, R. 87 No 9b/2011