Effect of nitrocarburising treatment on the microstructure and wear resistance of Cr-Mo and Ni-Mo-Cu low-alloyed PM steels

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THE PAPER PURPOSE:

To establish an efficient thermochemical treatment for improving the wear resistance of parts made from low-alloyed PM steels.

EXPERIMENTAL CONDITIONS

- **Used powders:**
  - →**Astaloy CrM (Höganäs AB)**
  - →**Distaloy AB (Höganäs AB)**
  - →**Graphite**

- **Chemical composition of studied samples:**

Code	Base powder	Carbon content [%]	Cr [%]	Mo [%]	Cu [%]	Ni [%]
A-C01	Astaloy CrM	0.1	3	0.5	-	-
A-C04	Astaloy CrM	0.4	3	0.5	-	-
D-C02	Distaloy AB	0.2	-	0.5	1.5	1.75
D-C04	Distaloy AB	0.4	-	0.5	1.5	1.75

- **Compactation:**
  - →**Cold uniaxial compaction in a steel die, at 800 MPa**

- **Sintering cycles:**
  - →**Sintering temperature: 1120°C**
  - →**Atmosphere: 90% N_2 – 10%H_2**
  - →**Time at temperature: 30 minutes**

- **Nitrocarburizing treatment:**
  - →**Atmosphere: 74% N_2, 18.5%H_2 and 7.5%C_3H_8**
  - →**Temperature: 580°C and 720°C**
  - →**Time at temperature: 15 h**

- **Product characterisation by determination of:**
  - →**Vickers microhardness**
  - →**Disk on disk wear test**
    - **Load: 500 N**
    - **Sliding speed: 0.0762 m/s**

RESULTS AND DISCUSSION

- **The effect of nitrocarburizing treatment on the samples microstructure:**

  →The thickness of the layer influenced by the treatment is about 0.5 mm

  →Samples treated at lower temperature present a microstructure formed by bainite with separation of secondary cementite on the diffusion layer for the samples with a higher carbon content

  →Samples treated at a higher temperature present hardening structure in the surface layer

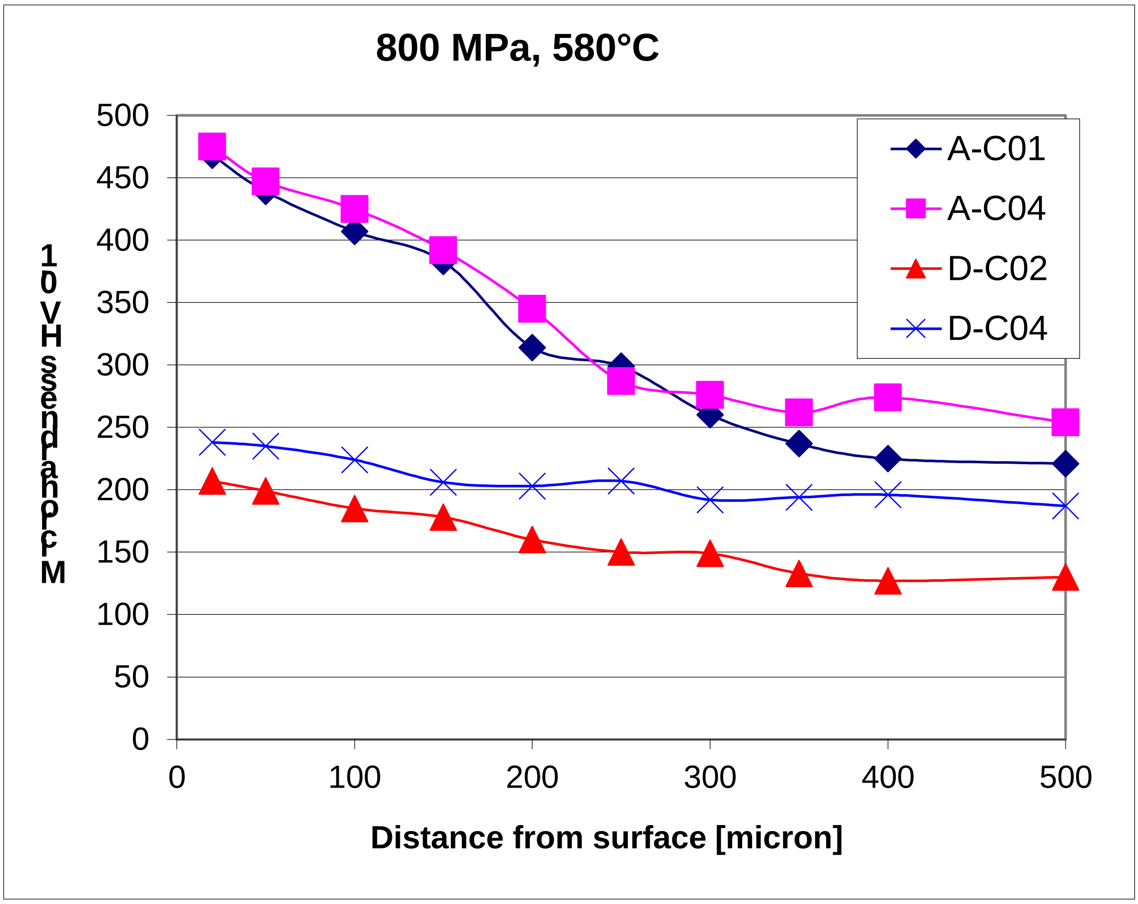
- **Microhardness profile:**

  →Treatment at 580°C

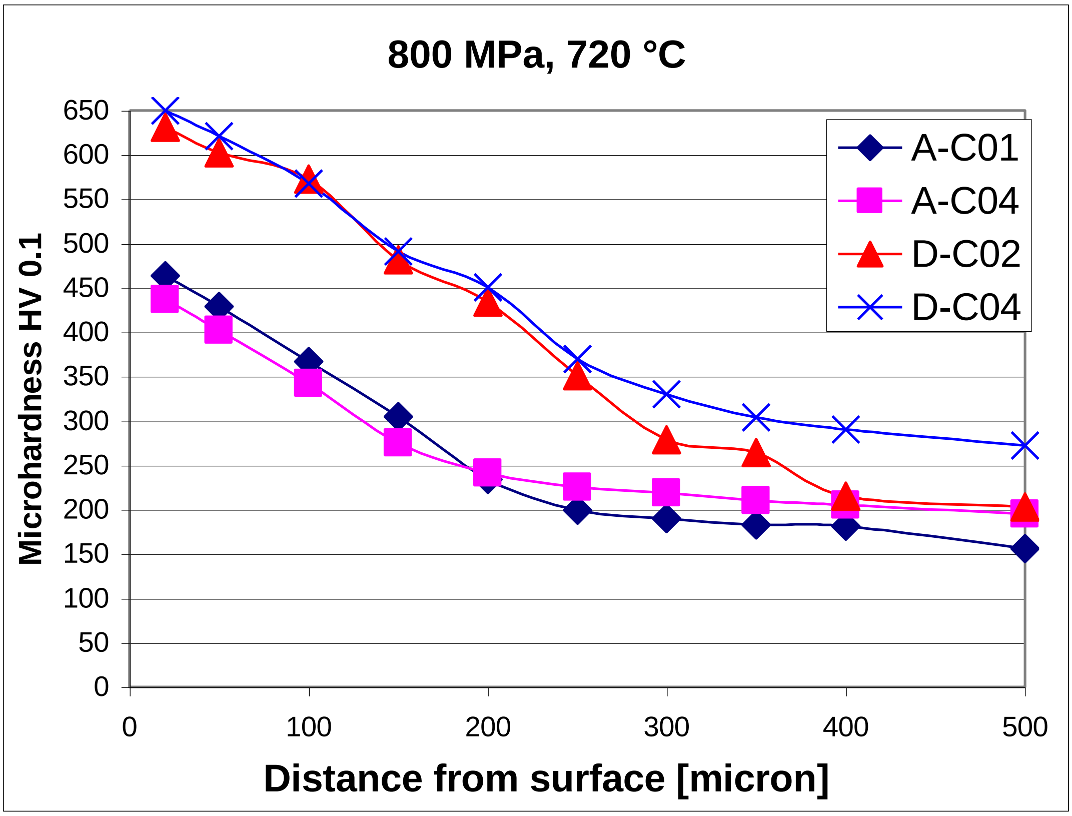
  - **Increasing the microhardness of samples made from Astaloy CrM**
  - **Have an insignificant effect on the microhardness of samples made from Distaloy AB**
  - **At this temperature predominate the nitriding effect, Cr having a high a higher affinity for N_2**

  →Treatment at 720°C

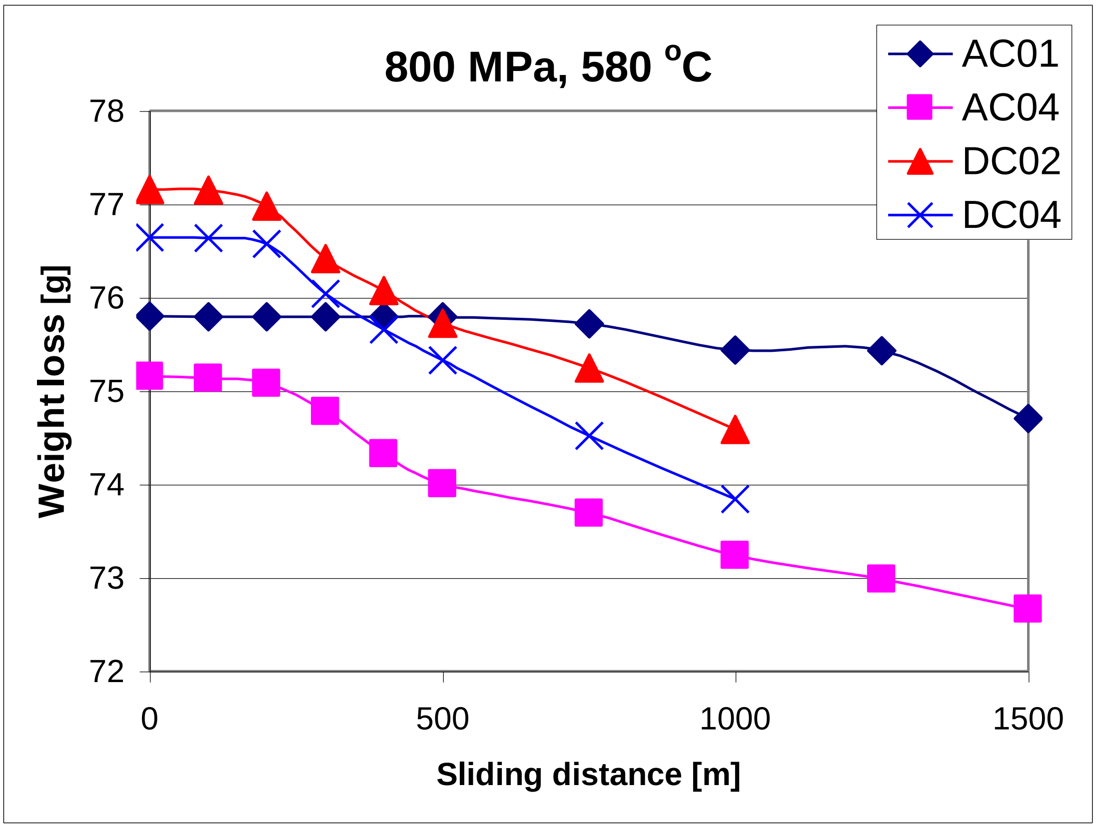
  - **Have no improve samples made from Astaloy CrM have a microhardness similar**
  - **Microhardness of samples made from Distaloy AB have an important increase**
  - **At this temperature the carburising effect becomes predominant. This higher temperature is able to determine the formation of proper hardened diffusion layers on Fe-Cu-Ni-Mo-C systems**



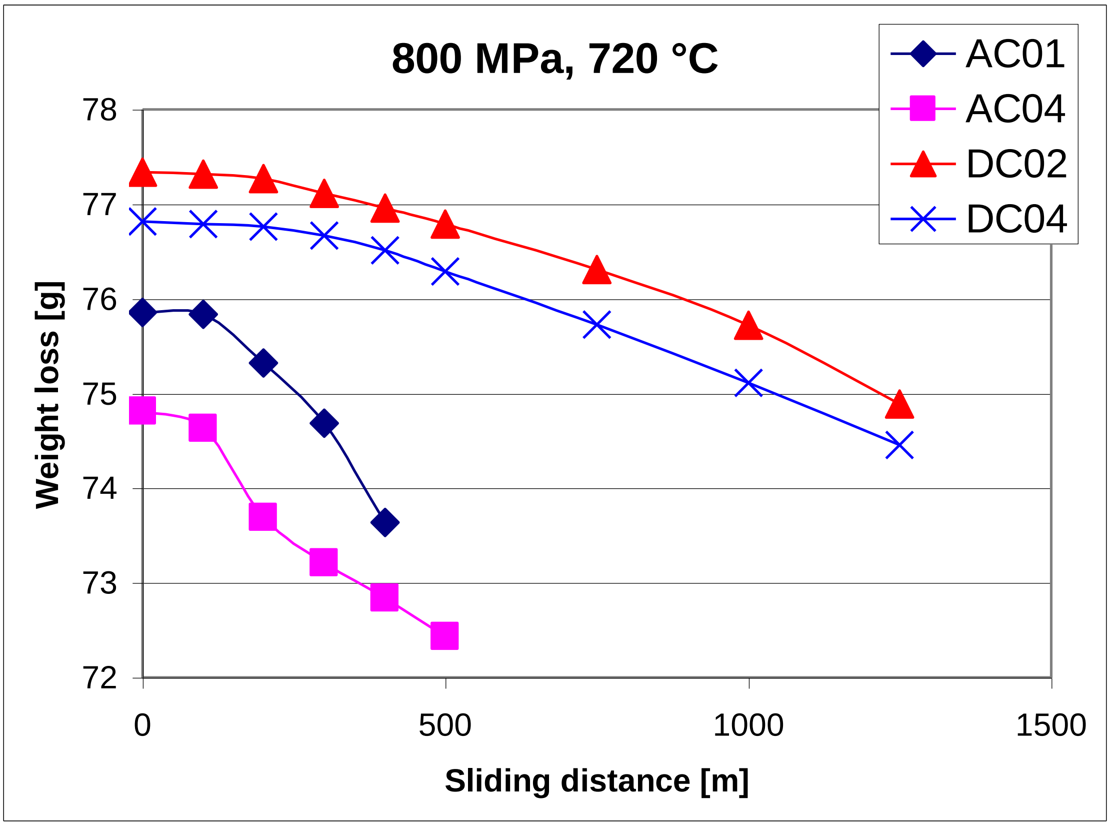
Microhardness profile of samples nitrocarburized in plasma at 580°C.



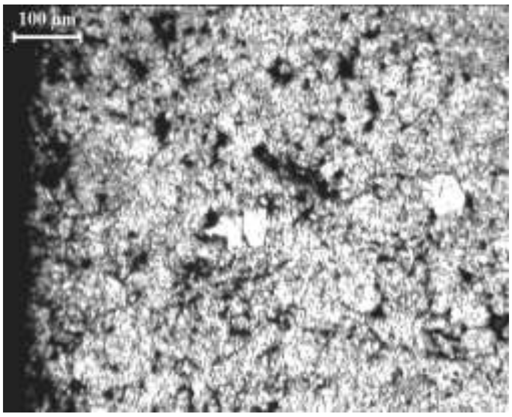
Microhardness profile of samples nitrocarburized in plasma at 720°C.



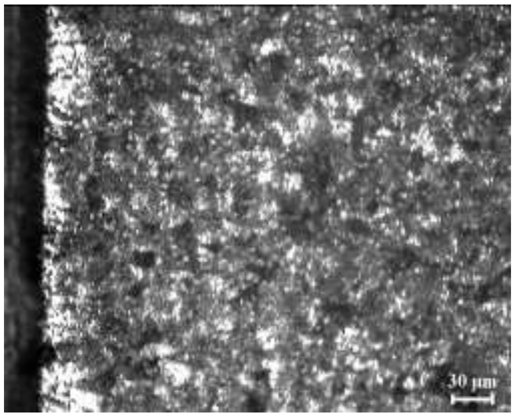
Wear resistance of samples nitrocarburized in plasma at 580°C



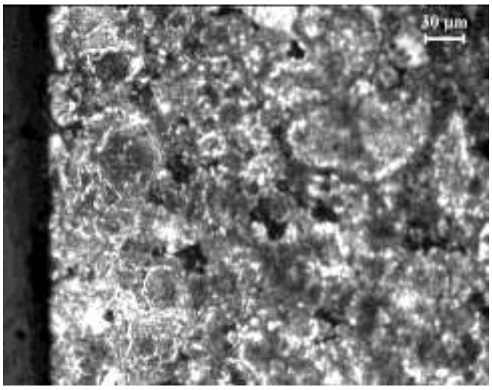
Wear resistance of samples nitrocarburized in plasma at 720 °C



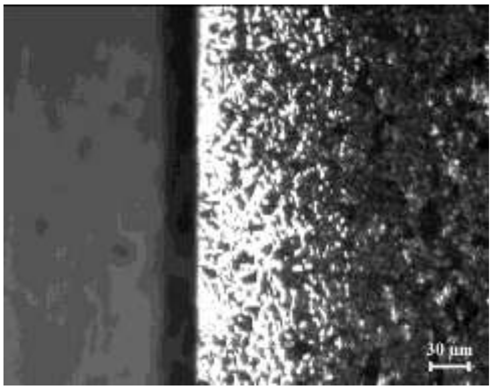
Microstructure of sample A-C01 treated at 580°C



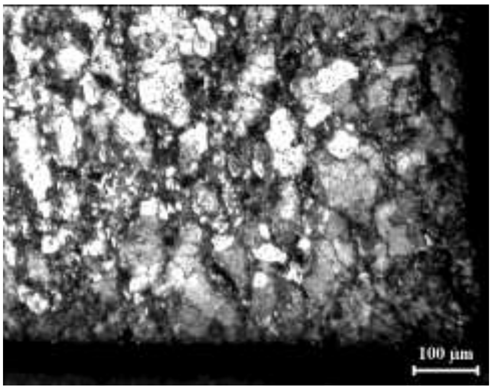
Microstructure of sample A-C01 treated at 720°C



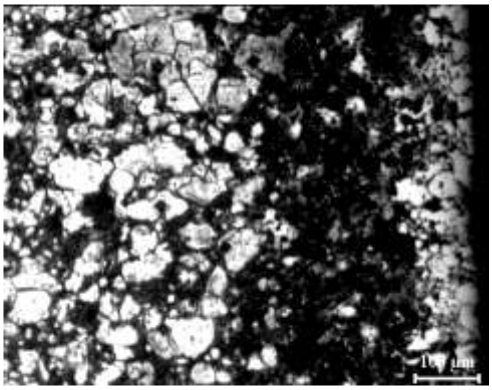
Microstructure of sample A-C04 treated at 580°C



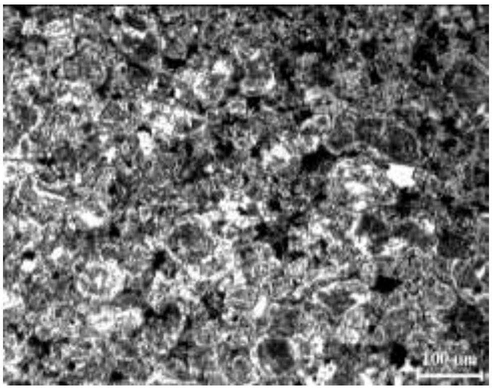
Microstructure of sample A-C04 treated at 720°C



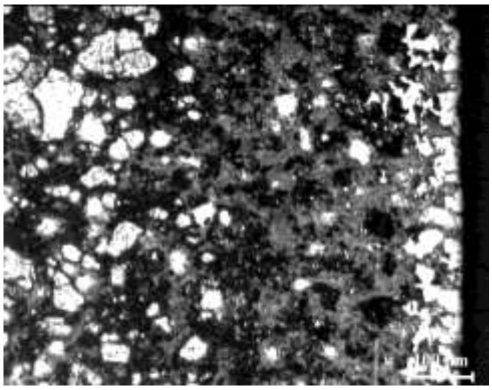
Microstructure of sample D-C02 treated at 580°C



Microstructure of sample D-C02 treated at 720°C



Microstructure of sample D-C04 treated at 580°C



Microstructure of sample D-C04 treated at 720°C

CONCLUSIONS

The effect of nitrocarburizing treatments at two different temperatures has been examined

- **The first evident difference is in the microhardness profile that relives a decrease from diffusion layer to the matrix**
- **The different temperatures of nitrocarburizing treatment have not an important influence on the microhardness of samples made from Astaloy CrM, but influence the wear resistance**
- **The treatment at 720°C determines significant improvements in the microhardness and wears resistance of the sample made from Distaloy AB**