Acta Microscopica, Vol.6, Supl.A, September 1997.
Proc. XVI Meeting of the Brazilian Society for Electron Microscopy.

THE RELATIONSHIP BETWEEN THE MANGANESE SULFIDE PRECIPITATION DURING HOT COMPRESSION PROCESS WITH ONE AND TWO HOLDING TIME IN GRAIN ORIENTED ELECTRICAL STEEL.

V.A.Rodrigues, W.A.Monteiro, A.M.S.-Silva, N.A.M.Ferreira, L.C.E.Silva.
IPEN/CNEN-São Paulo-S.P., CEP:05508-900, C.P.11.049, CEP:05422-970, Brazil.

The importance of most soft magnetic materials relates to the generation and use of electrical power. Production of electricity has been doubling each decade and the outlook is for this increasing use to provide for even expanding services required by increased population and higher living standards. Iron and low carbon silicon-iron with very low impurity content provides the high permeability and very low core loss needed for large transformers at reasonable cost .The metallurgists have played an important and, sometimes, essential role in the development of industrial magnetic products.[1,2]

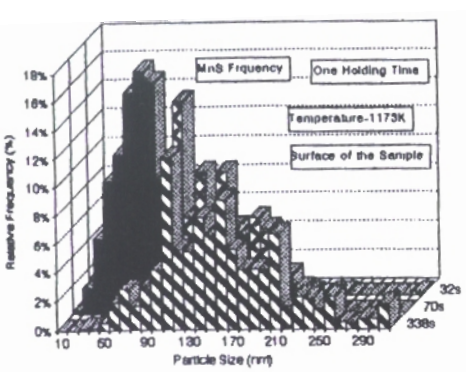
The aim of this work is the study of manganese sulfide precipitation during hot compression process with one and twoholding time.

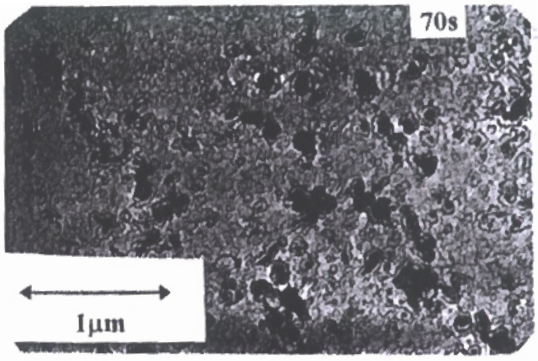
In order to make the precipitation comparison between the two processes, all samples were heated at 1573K for 1800s. After this heat treatment the specimens were cooled down to 1373 and 1173K, hold at each temperature for 32, 60 and 338s with 50% compression and then water quenched. The same procedure was used in the process with two holding time, with 50 and 30% compression. The characterization of grain size was carried out using optical microscopy. The study of the comparison precipitation has been carried out on the surface and the center of each sample in the two processes. For TEM characterization of MnS particles an extraction replica technique has been used. The particle diameter was measured by image analyser.

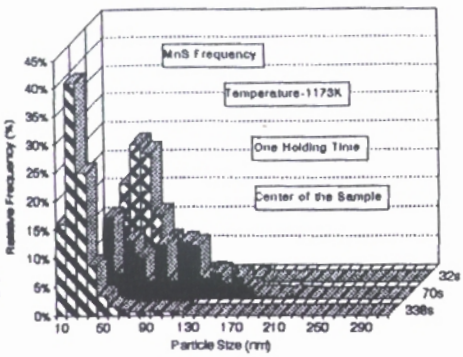
Optical micrographs showed that grain size diminishes with two holding time time process for two temperatures on the surface and in the center of the sample.One of the electron micrographs obtained after compression test at 1173K and 1373K for 32, 60 and 338s on the surface and the center of the sample is shown at right of figures 1 and 2, while the size distribution associated with these samles is displayed at left on each figure. It can see that particles diameter after the hot compression is minor with two holding time than in the process with one holding time, (on the surface and in the center of the sample). Hot compression with two holding time provides more dislocation and defects on the center of the sample increasing the possibility of MnS particles precipitate and providing higher MnS particle density. On the other hand, nucleation is preferred at high temperatures (1373K). and nucleation occurs preferentially at grain boundaries. Dislocations provide more sites for nucleation than grain boundaries, hence their density increases with temperatures.[3]

References.

[1] A technical report by Armco Steel Corporation, Middletown Ohio, October-1970.
[2] C.W. Chen."Magnetism and Metallurgy of Soft Magnetic Materials".Dover Publications, Inc., New York, 1986, (171).
[3] W.P.Sun, M.Militzer and J.J. Jonas.Metal.Trans.A, 23A (1992), 821.







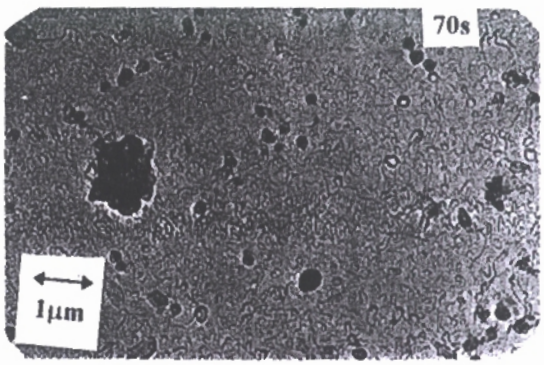
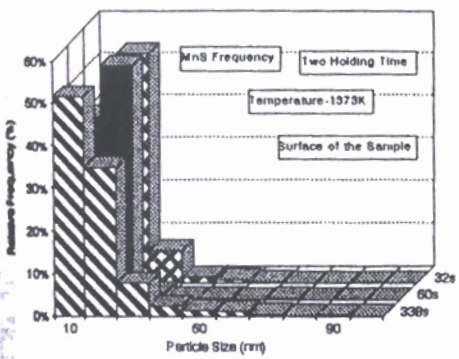
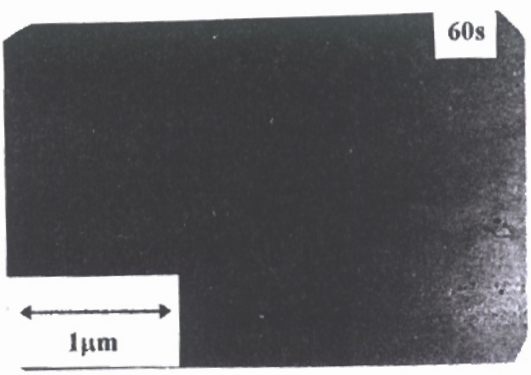
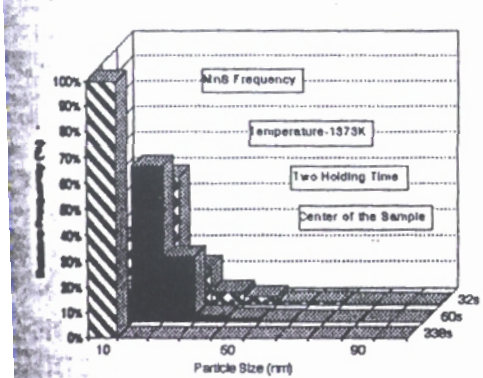


Fig.1.MnS precipitates and their particle size distribution at 1173K.







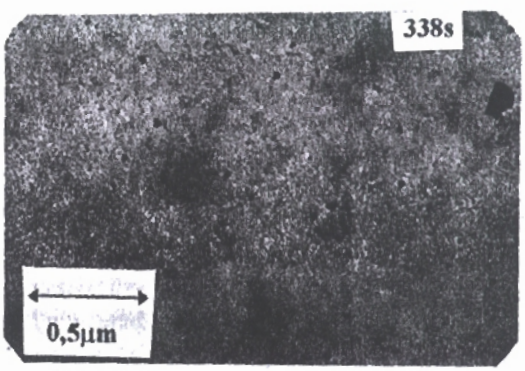


Fig.2. MnS precipitates and their particle size distribution at 1373K