07.5-1   ELECTRON MICROSCOPY AND X-RAY STUDY OF
AMORPHOUS ALLOY $Fe_{40}Ni_{40}B_{20}$. By J.A. Zaharidova and V.C.
Anchev, Department of Metallurgy, Sofia Higher Institute
of Mechanical and Electrical Engineering, Sofia 1156,
Bulgaria.

The crystallization of magnetic Fe-Ni-B metallic glasses
has been investigated extensively in recent years. In
the present paper attempts have been made to study the
crystallization behaviour of amorphous alloy $Fe_{40}Ni_{40}B_{20}$.
Ribbon samples of amorphous alloy $Fe_{40}Ni_{40}B_{20}$ were
annealed between 573 K and 673 K under isothermal
heating conditions for different times. The crystalline
phases were identified using X-ray diffraction (XRD) and
selected-area electron diffraction (SAD) in transmission
electron microscopy (TEM).
TEM images show that a coarse dark-bright cloudy
structure is typical for specimens annealed at 573 K for
3.6, 7.2, 14.4 and 28.8 ks and at 623 K for 300s. SAD
and XRD results confirm the amorphous state.
Annealing at 623 K for 1.8 ks leads to changes in the
amorphous matrix. The coarse cloudy dark-white contrast
is more pronounced. The diffraction patterns are still
those of the amorphous state, but the intensity of the
first diffuse ring is increased. We can assume that a
local enrichment of metallic atoms takes place during
heating.
After heating at 623 K for 3.6 ks the electron
microscopy shows that there are small crystallites
embeded in the amorphous matrix. The last one remains in
a fine grained dark-bright contrast, according to the
scattered absorption. The X-ray data show that weak
diffraction peaks of crystalline (Fe,Ni)-fcc solid
solution and $(Fe,Ni)_3B$ orthorhombic phase appear.
After heating at 648 K for 300 s, 1.8 ks and 3.6 ks
small crystallites of different quantities are
observed. On the basis of XRD and SAD results, these
crystallites are found to be mixture of eutectic phases
- (Fe,Ni)-fcc solid solution and orthorhombic $(Fe,Ni)_3B$.
Heating at 723 K for zero s leads to conservation of the
amorphous state, but after heating for 1.8 ks the alloy
is almost crystalline and after heating for 3.6 ks is
totally crystalline in the form of a fine mixture of
eutectic phases   - (Fe,Ni)-fcc solid solution and ortho-
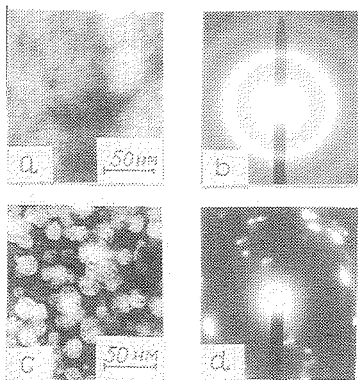rhombic $(Fe,Ni)_3B$.

Fig.1 TEM images and SAD of samples
       after annealing at : a,b)$623°K$
       for 1,8 ks, c,d)$648°K$ for 3,6ks

07.6-1   HYDROGEN ABSORPTION BY M_5X_3 PHASES.
ABSTRACT. By N.J. Clark and E. Wu, School of Physical Sciences, Flinders
University of South Australia, Australia.

The M_5X_3 phases crystallise in four principal structure types,
namely the hexagonal Mn_5Si_3 type, the tetragonal W_5Si_3 and Cr_5B_3 types
and the orthorhombic Y_5Bi_3 type.

Y_5Si_3 and Ho_5Si_3 with the $P6_3/mcm$ space group, (Mn_5Si_3 type) absorb
hydrogen reversibly with production of a supercell and are sensitive to oxygen
and carbon poisoning. A number of compounds with this stoichiometry which
adopt the Mn_5Si_3 structure are believed to require inclusion of oxygen or
carbon to stabilise the structure, (the so-called Nowotny phases), and would
be expected to be inactive in hydrogen absorption. The question arises whether
other M_5X_3 phases with alternative structures can absorb hydrogen.

To elucidate further the importance of structure upon hydrogen absorption,
investigations of Zr_5Al_3 with the $I4/mcm$ space group have been undertaken.
After activation at 100°C, Zr_5Al_3 absorbs hydrogen at room temperature and
one atmosphere to form $Zr_5Al_3H_8$ accompanied by a structure change. A
monoclinic cell, (space group unkown) with $a = 5.891Å$, $b = 11.075Å$, $c =
12.493Å$ and $\beta = 117.68°$ was determined by powder analysis. Between two
and three hydrogen atoms absorb and desorb on cycling up to 150°C. The
reversible absorption does not appear sensitive to oxygen contamination. When
oxygen is added to reach a composition of $Zr_5Al_3O_{0.5}$ during preparation of
Zr_5Al_3 a hexagonal phase with $a = 8.167Å$ and $c = 5.680Å$ is formed which
is presumably a Nowotny phase. Unlike Y_5Si_3 this phase is not poisoned by
the included oxygen and continues to exhibit significant reversible hydrogen
absorption.

The implications of these observations for the positions of the oxygen atoms
in the hexagonal structure and the mechanism for hydrogen absorption will be
discussed.

07.7-1   STRUCTURE DETERMINATION OF POTASSIUM-BENZENE
GRAPHITE INTERCALATION COMPOUND (GIC).   By H. Kurata,
K. Ishizuka, T. Kobayashi and N. Uyeda, Institute for
Chemical Research, Kyoto University, Uji 611, Japan.

A potassium-benzene GIC (K-Bz-GIC) were prepared by the
reaction of the liquid benzene with a second stage
potassium GIC synthesized by the two-zone method (D.E.
Nixon and G.S.Parry, J. Phys., 1968, D1, 291). The
composition of the final compound can be represented as
$KC_{24}(C_6H_6)_2$. Thin specimens of the K-Bz-GIC yield
electron diffraction pattern showing supperlattice spots
from the intercalant layers superimposed on graphite
spots. Two dimensional arrangement of potassium ions
and benzene molecules were deduced from a Patterson map
calculated only from the intercalant electron diffrac-
tions. Here, the angle of inclination of the benzene
molecules had been obscure.

The electron energy loss spectroscopy (EELS) was emploi-
ed to estimete the inclination angle of the benzene.
The orientation dependency of an electron energy loss
near edge structure (ELNES) of characteristic loss gives
a wealth of information on the geometrical structure as
well as electronic properties (R.D.Leapman et al., Phys.
Rev., 1983, B28, 2361). The electron energy loss
spectra were obtained by using JEM-100C equiped with a
magnetic sector spectrometer. The orientation dependence
of ELNES of carbone K edge (C_K) corresponding to the 1s
-> π^* transition was analyzed. The orientation depend-
ence of K-Bz-GIC differs from that of graphite, which
clearly shows the molecular planes of benzene in
K-Bz-GIC are not parallel to graphite layers. The
theoretical calculations using the similar method as
Leapman et al. yield a good agreement with the
experimental data when the inclination angle of 35 - 40°
is assumed.