

# N90-22657

## Program 5    **The Effects of Zinc Addition on the Environmental Stability of Al-Li Alloys**

Raymond J. Kilmer and G.E. Stoner

### Objectives

The objectives for this study are:

- 1) to document and correlate the microstructure of the ALCOA provided 8090 + Zn alloy with corrosion behavior and SCC phenomena;
- 2) to identify the intermetallics present in 8090 + Zn alloy most notably in the aging regimes displaying optimal mechanical properties;
- 3) to compare and contrast with baseline 8090 with regard to corrosion and SCC behavior in a number of environments.

The Role of Zn Additions to the Environmental Stability  
of Alloy 8090

R.J. Kilmer and G.E. Stoner

Department of Materials Science

It has been found that relatively small additions of Zn can improve the stress corrosion cracking (SCC) resistance of Al-Li alloys. However, the mechanism by which this is accomplished is unclear. This present project will investigate the role that Zn plays in altering the behavior of Alloy 8090. Early results suggest that Zn additions increase the volume fraction of  $\delta'$  ( $\text{Al}_3\text{Li}$ ) precipitation and differential scanning calorimetry (DSC) on these alloys confirms this. The four alloys studied each had initial compositions lying in the 8090 window and had varying amounts of Zn added to them.

Alloy 8090, like other Al-Li alloys, displays a  $\delta'$  precipitate free zone (PFZ) upon artificial aging along the grain and subgrain boundaries. However Zn additions greatly decreased or eliminated a  $\delta'$  PFZ after 100 hours at 160°C. This implies that the subgrain boundary precipitation kinetics are being altered and suppressed. Furthermore there appears to be a window of Zn concentration above which a  $\delta'$  PFZ can reappear with the nucleation and growth of a currently unidentified precipitate on the boundaries.

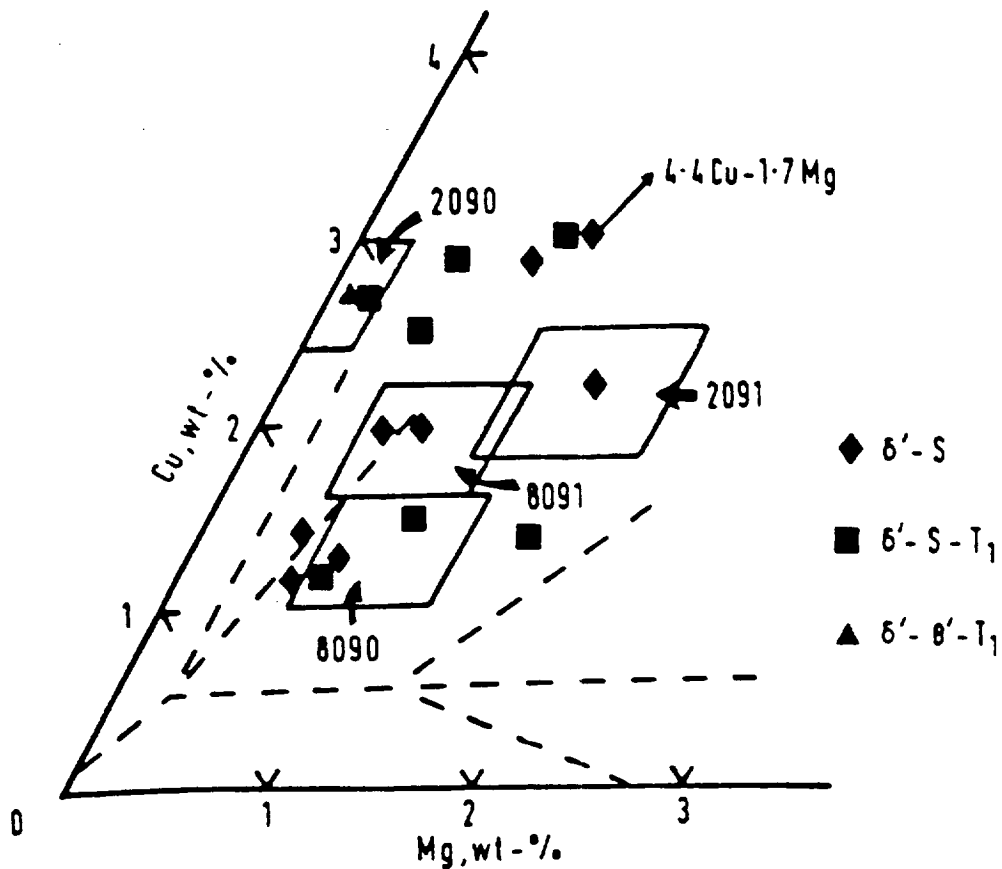
Polarization experiments were performed and the results presented. The experiments were performed in deaerated 3.5 w/o NaCl in both the as received (T3) condition and at peak aging of 100 hours at 160°C. The aging profile was determined via Vickers Hardness tests.

A proposed outline of the project will be presented with future research a main focus.

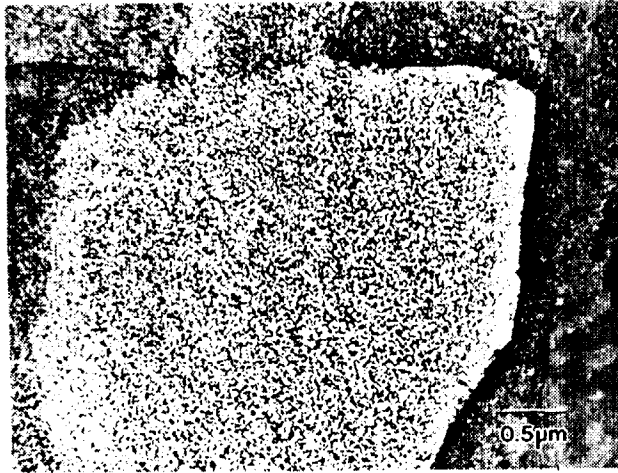
Sponsored by NASA, Langley Research Center, Hampton Virginia  
Alcoa, Alcoa Technical Center, Alcoa Center, Pennsylvania

8090

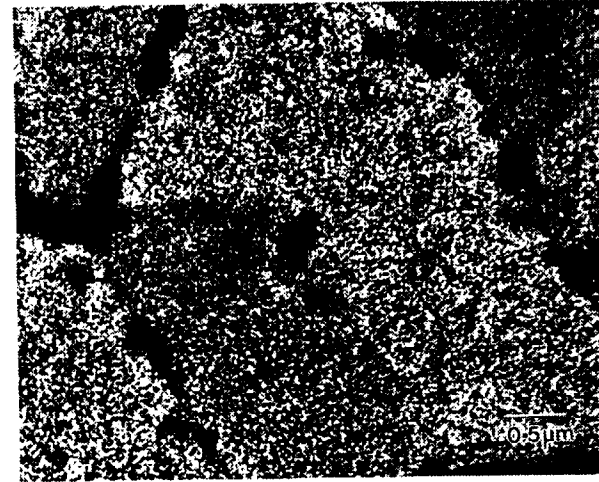
Al-2.4Li-1.16Cu-0.67Mg-0.12Zr



Precipitate phases reported in quaternary Al-Cu-Mg alloys containing 2-3 wt-%Li in material aged at 190°C; where original source quotes composition range, centre of that range has been used as composition shown here; composition ranges of internationally designated Al-Li-Cu-Mg alloys and precipitate phase fields of ternary Al-Cu-Mg system at 190°C are also shown



8 hrs

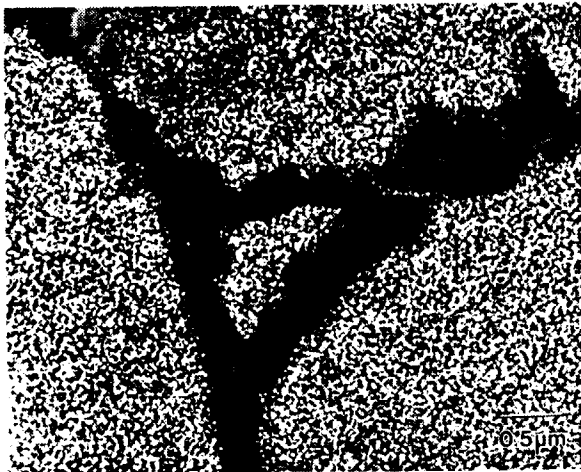


15 hrs

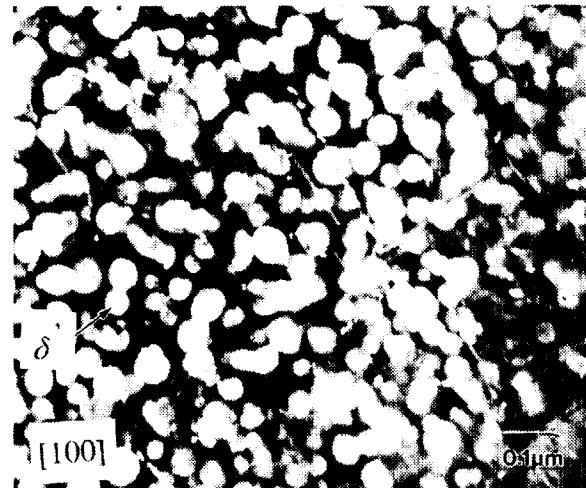
8090 Plate

Aging Temperature

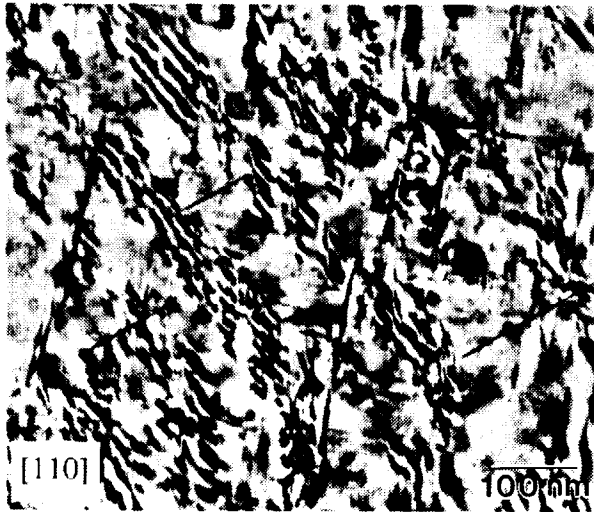
192 C



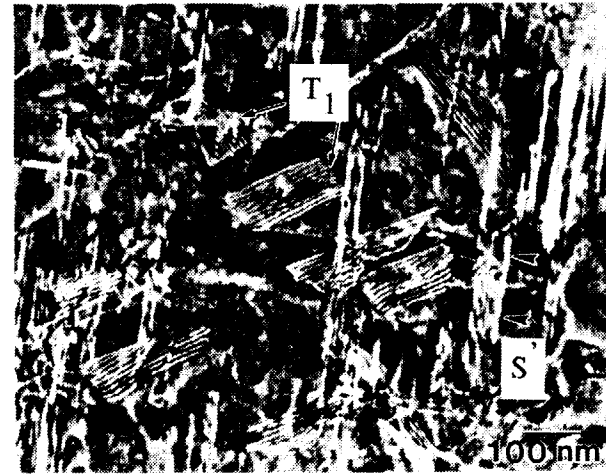
30 hrs



71 hrs



30 hrs

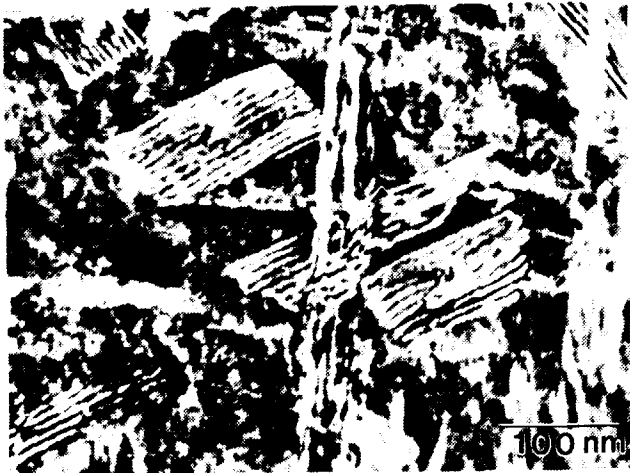


30 hrs

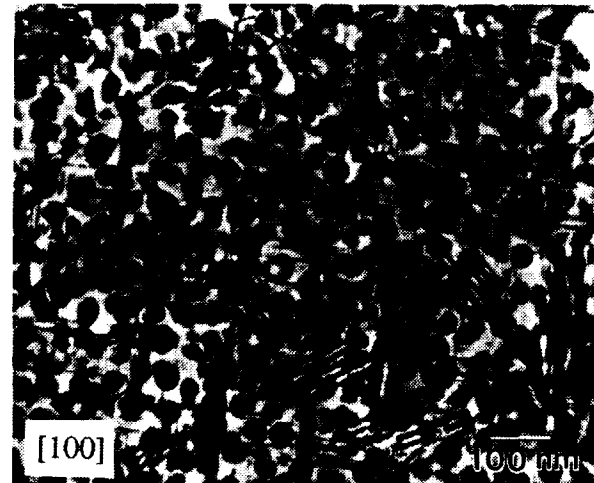
8090 Plate

Aging Temperature

192 C



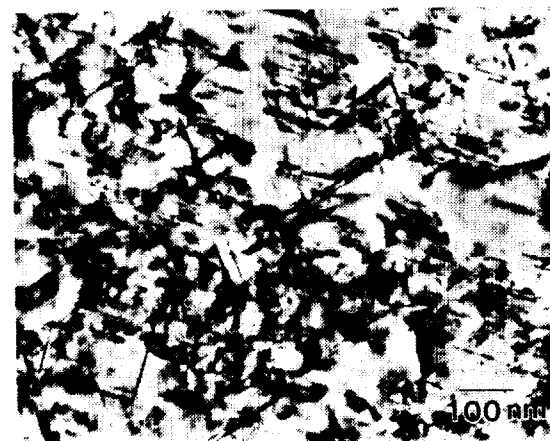
30 hrs



71 hrs



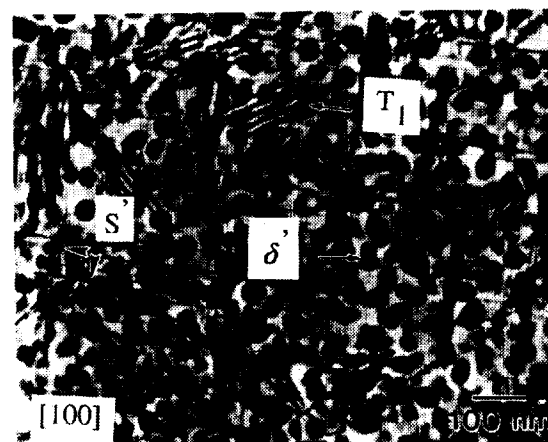
8 hrs



15 hrs



30 hrs



71 hrs

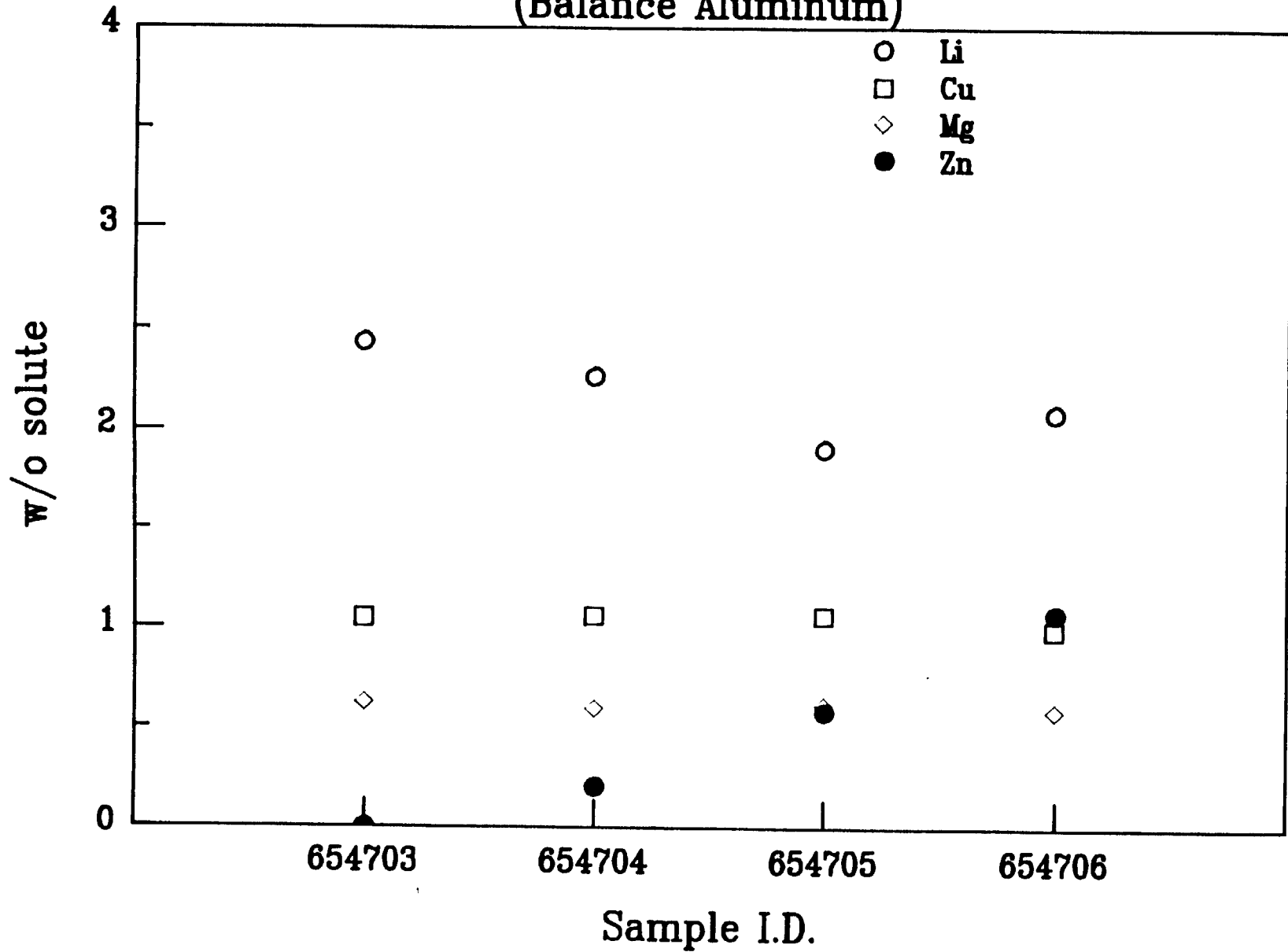
## 8090 + Zn Variants - Sheet

Atomic percent ratios

<u>Sample I.D.</u>	<u>Target Alloy</u>	<u>Li/Zn</u>	<u>Cu/Zn</u>	<u>Mg/Zn</u>
654703	8090 Baseline	-	-	-
654704	8090 + 0.21w/o Zn	101.8	5.2	7.7
654705	8090 + 0.58w/o Zn	31.0	1.9	2.9
654706	8090 + 1.07w/o Zn	18.4	1.0	1.5

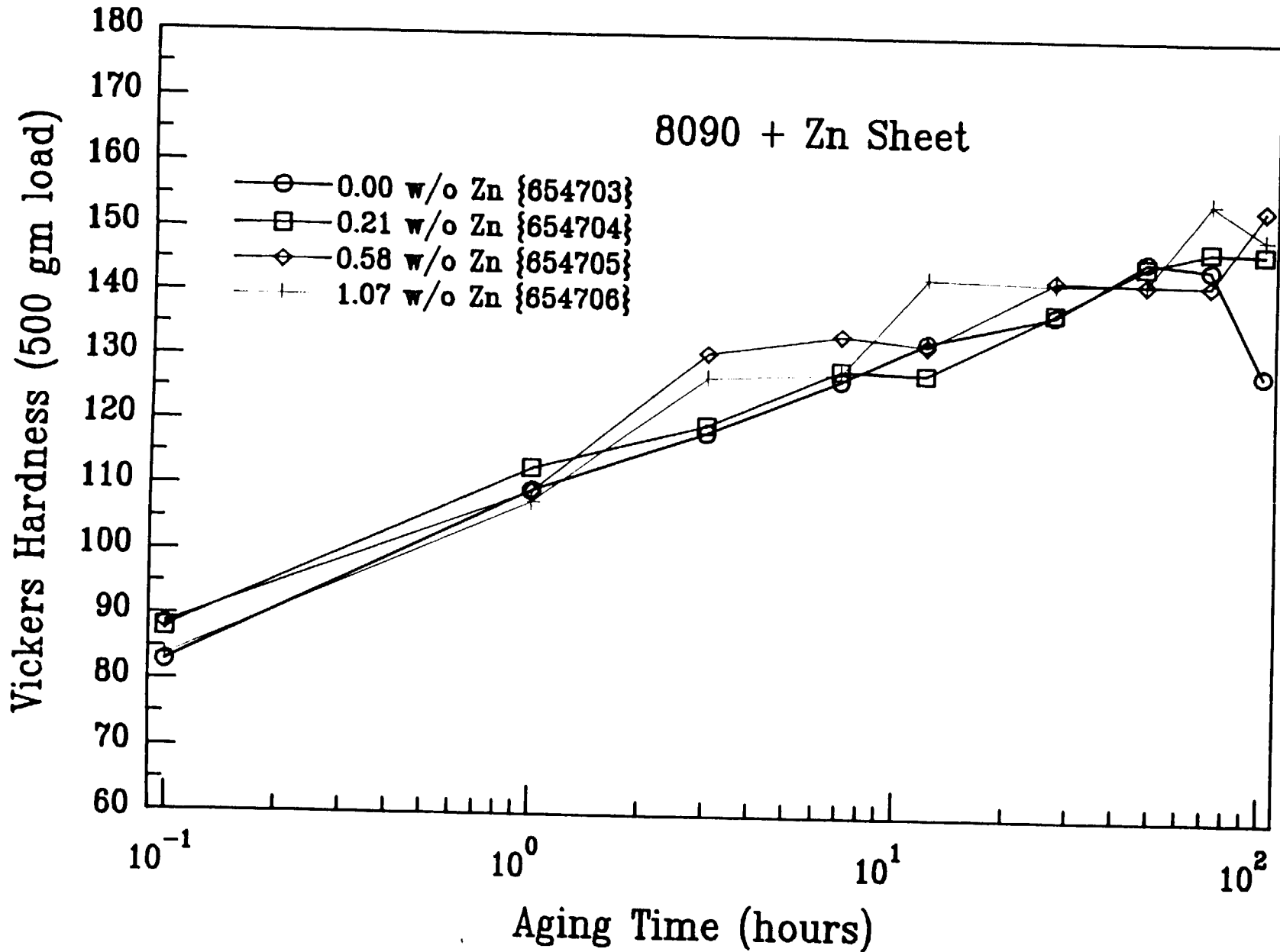
# 8090 + Zn Sheet

(Balance Aluminum)

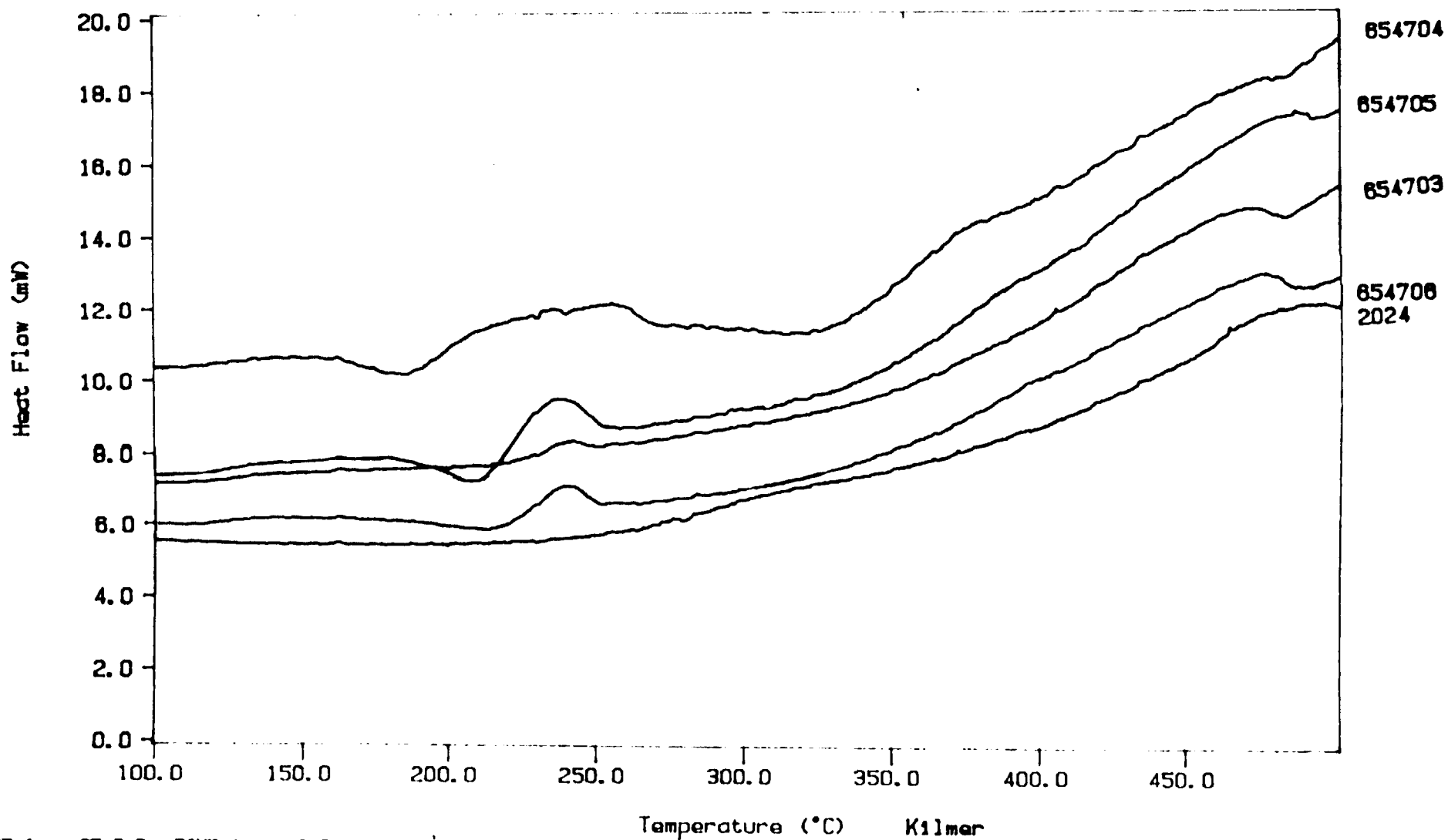




# AH 160



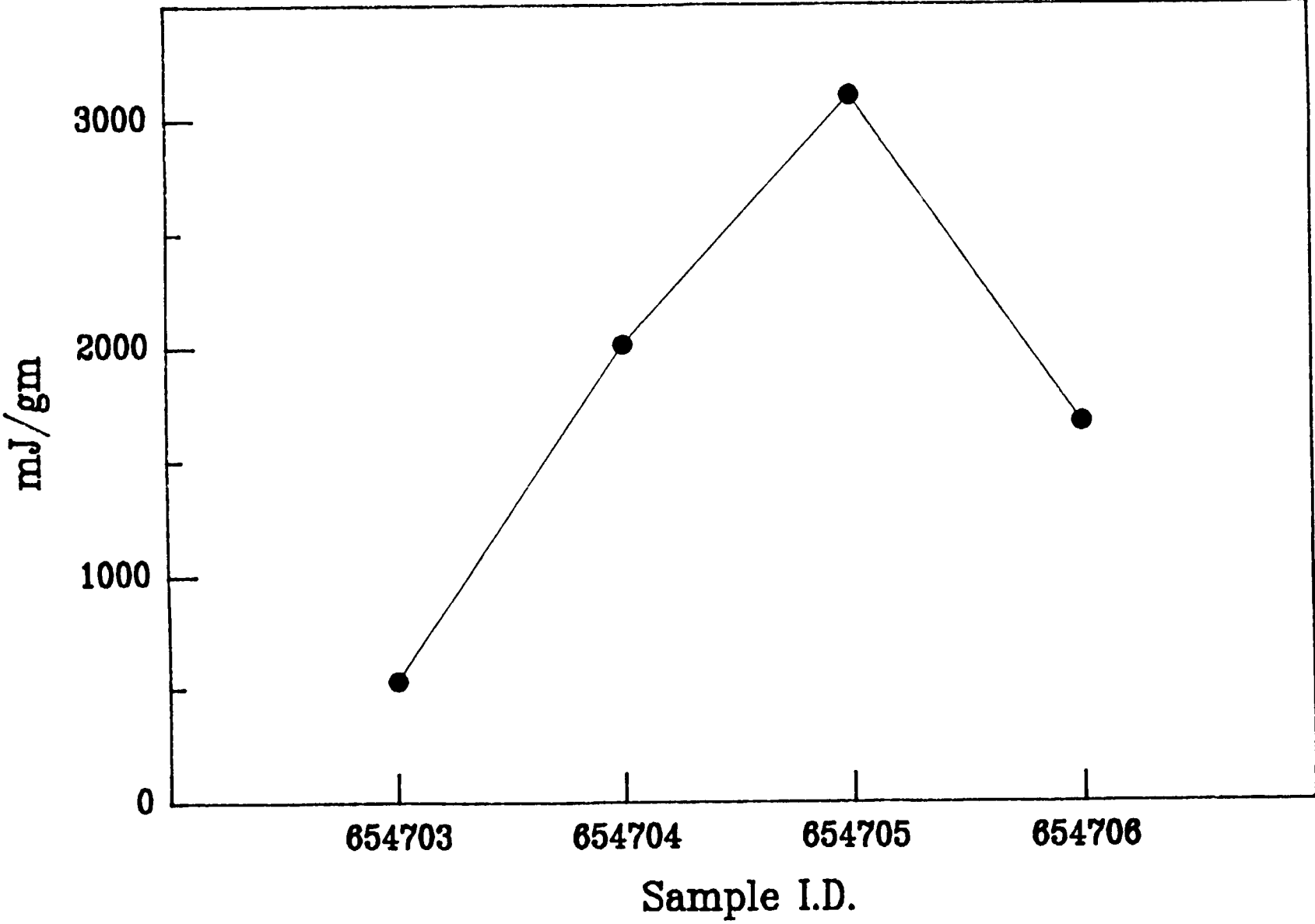
PERKIN-ELMER  
7 Series Thermal Analysis System

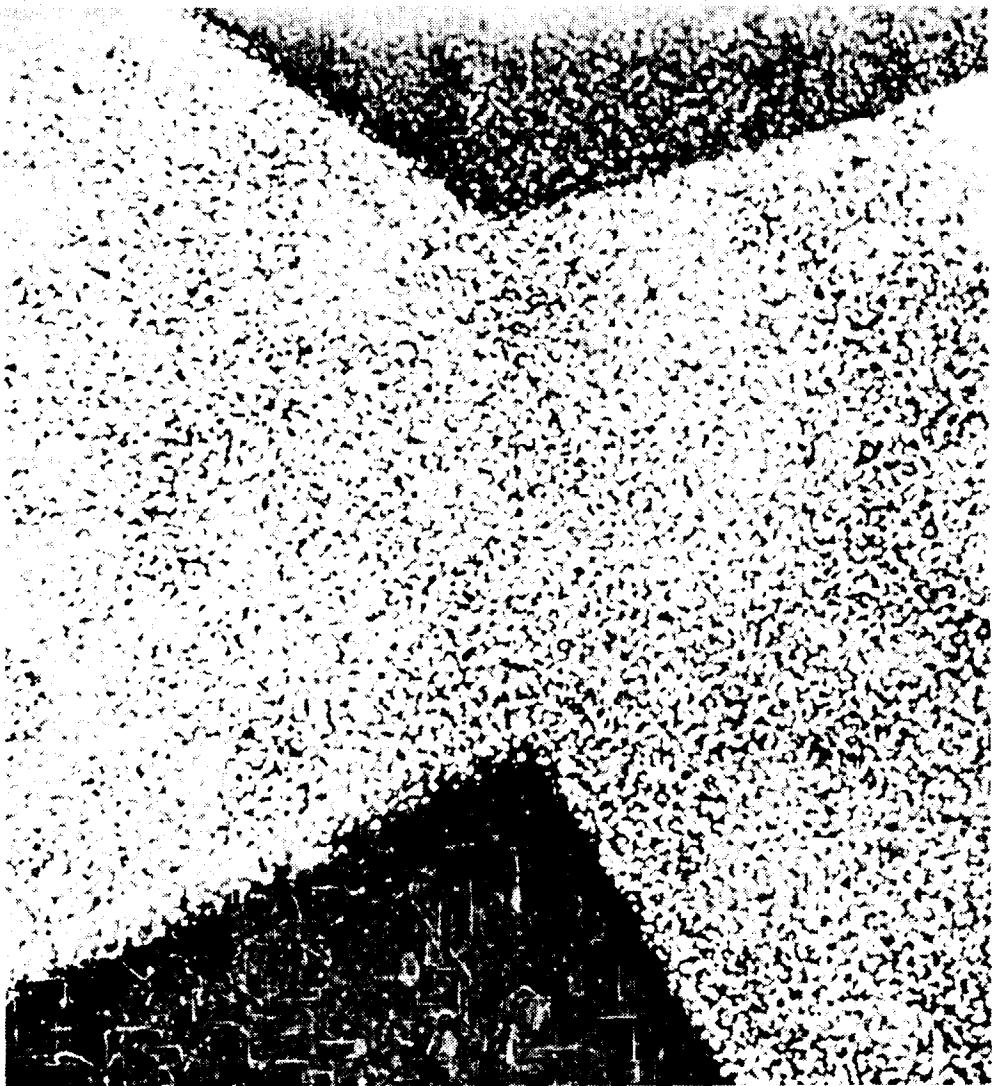


TEMP 1: 38.8 E TIME 1: 0.0 min RATE 1: 10.0 C/min

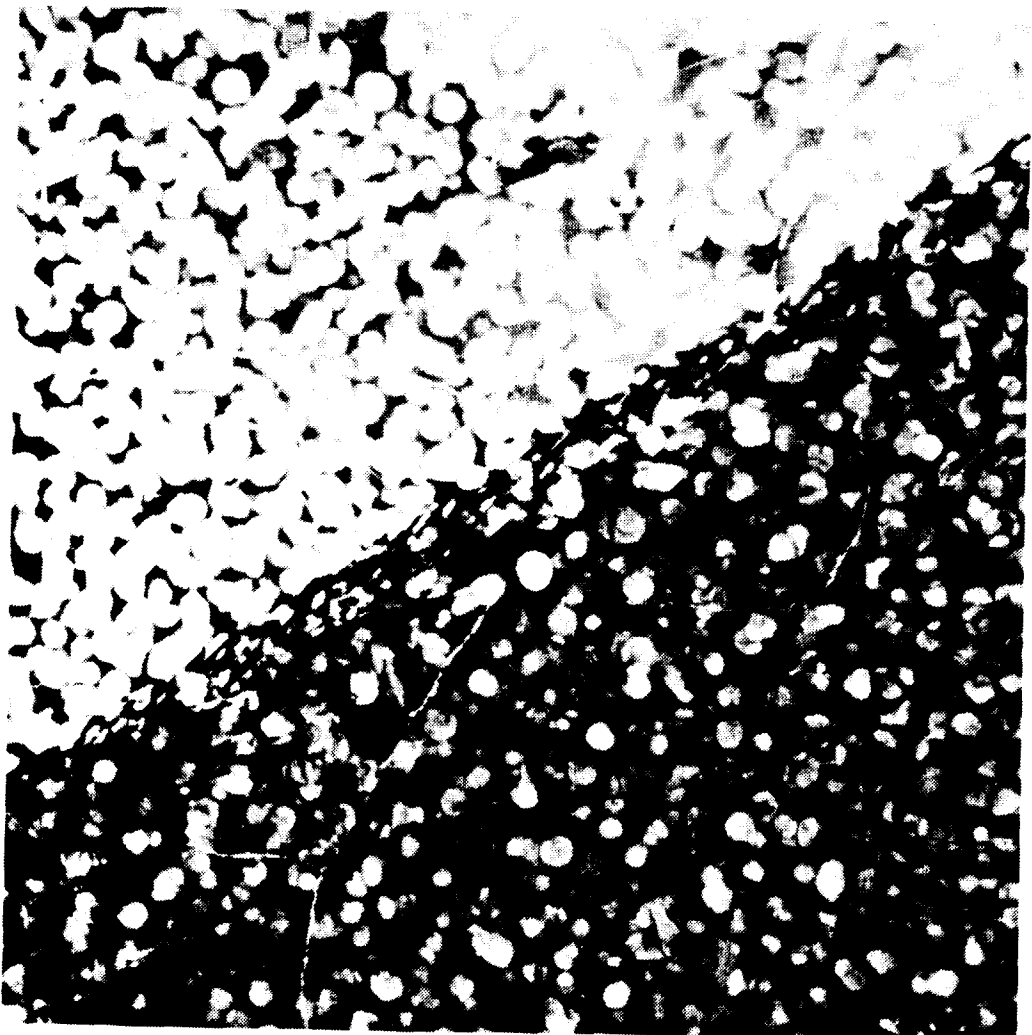
Temperature (°C) Kilmer

# DSC Results

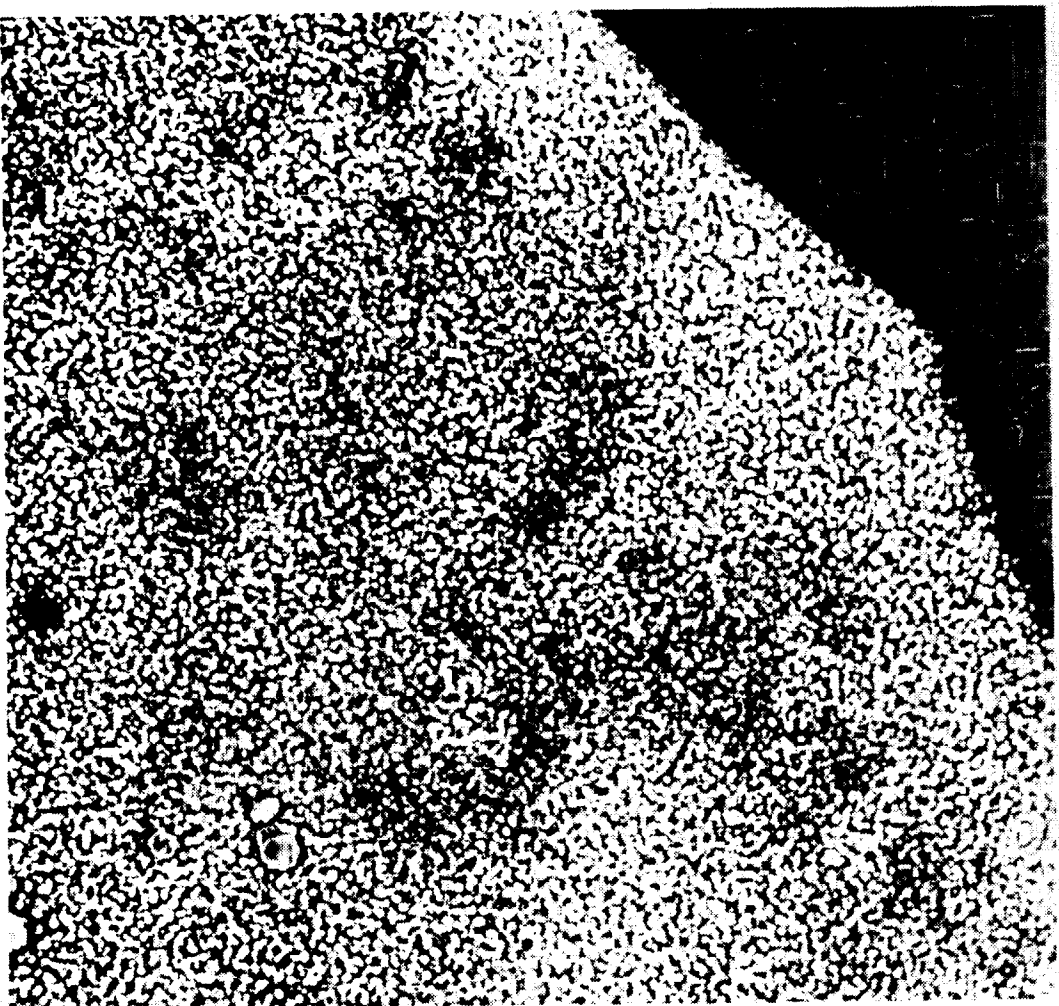




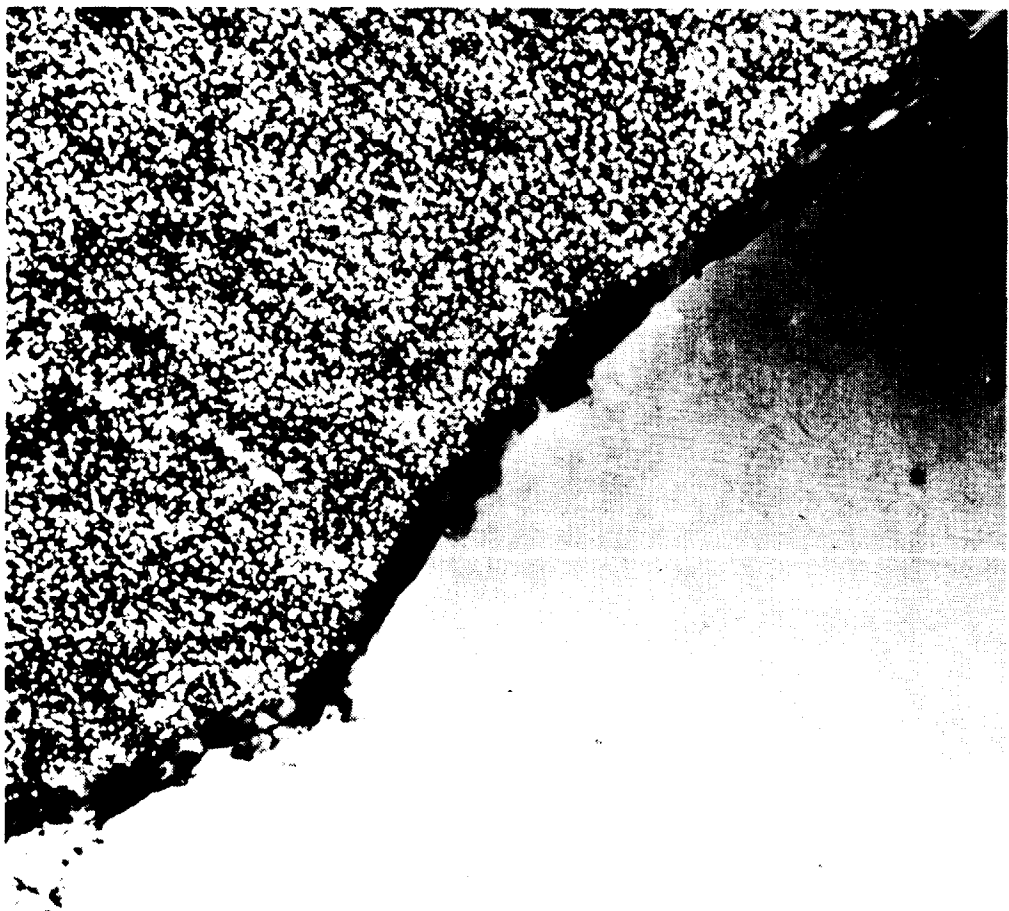
8090 + 0.2 w/o Zn (654704)



8090 + 0.2 w/o Zn (654704)



8090 + 0.5 w/o Zn (654705)



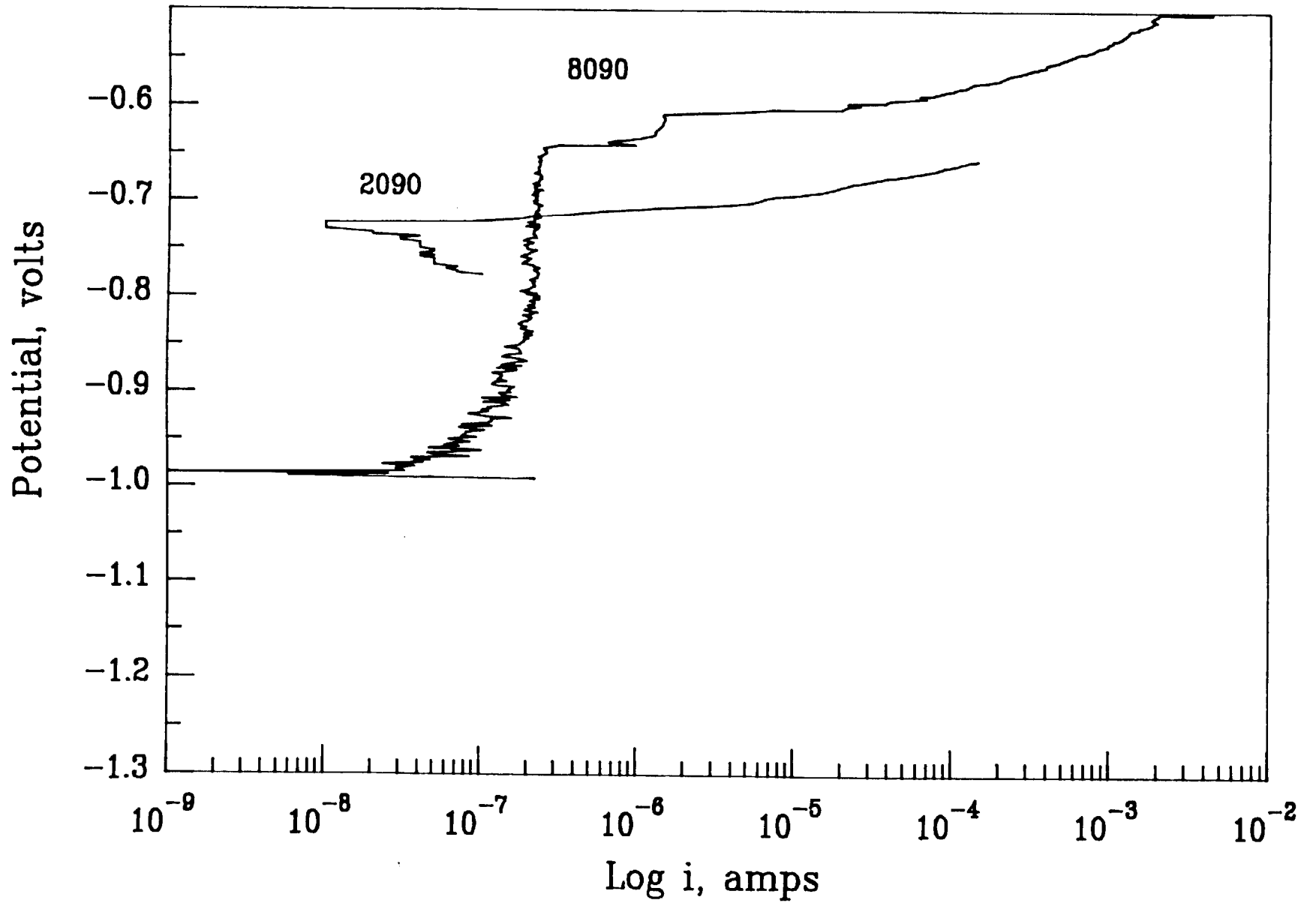
8090 + 1.0 w/o Zn (654706)



8090 + 1.0 w/o Zn (654706)

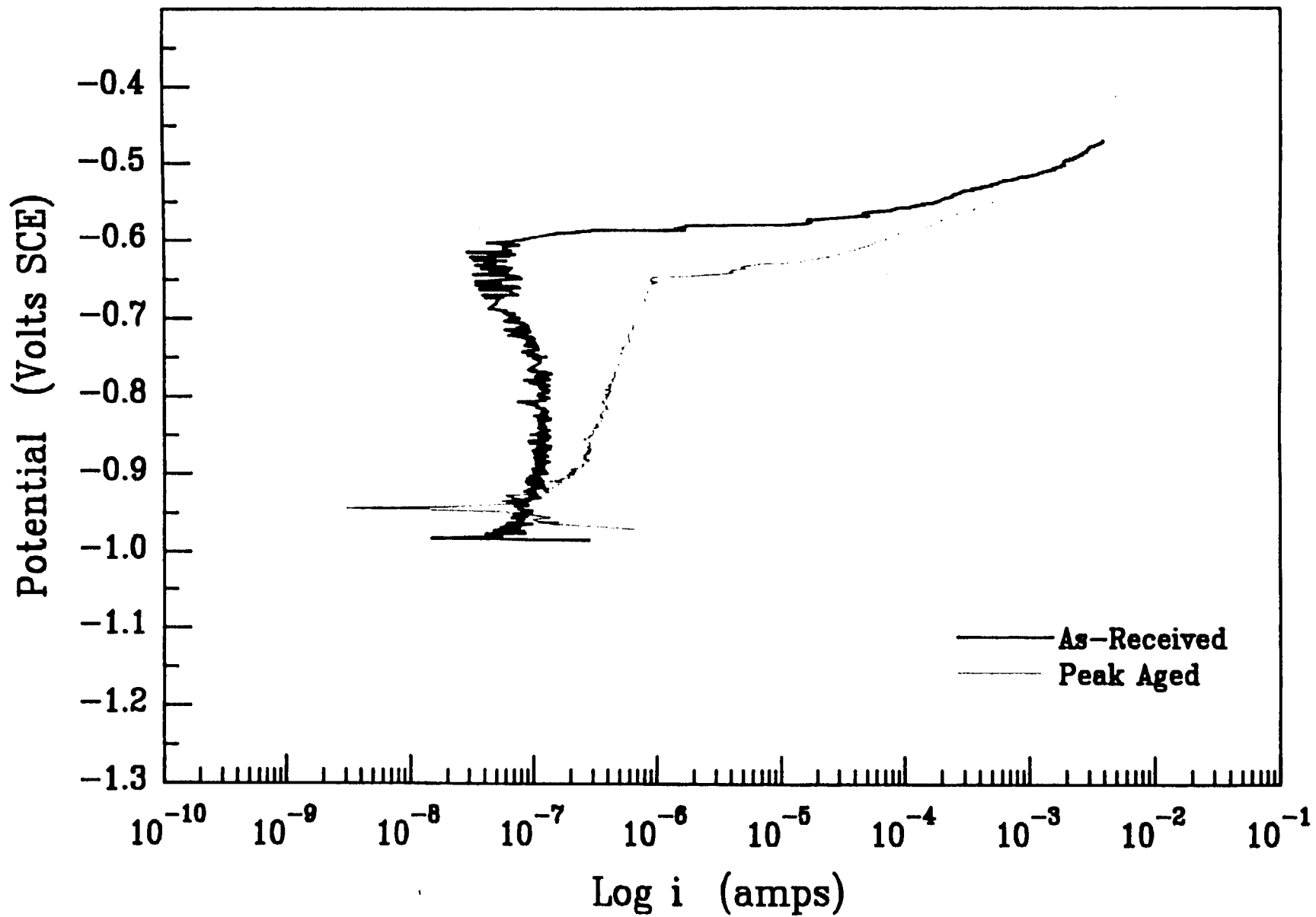


Deaerated 3.5 w/o NaCl

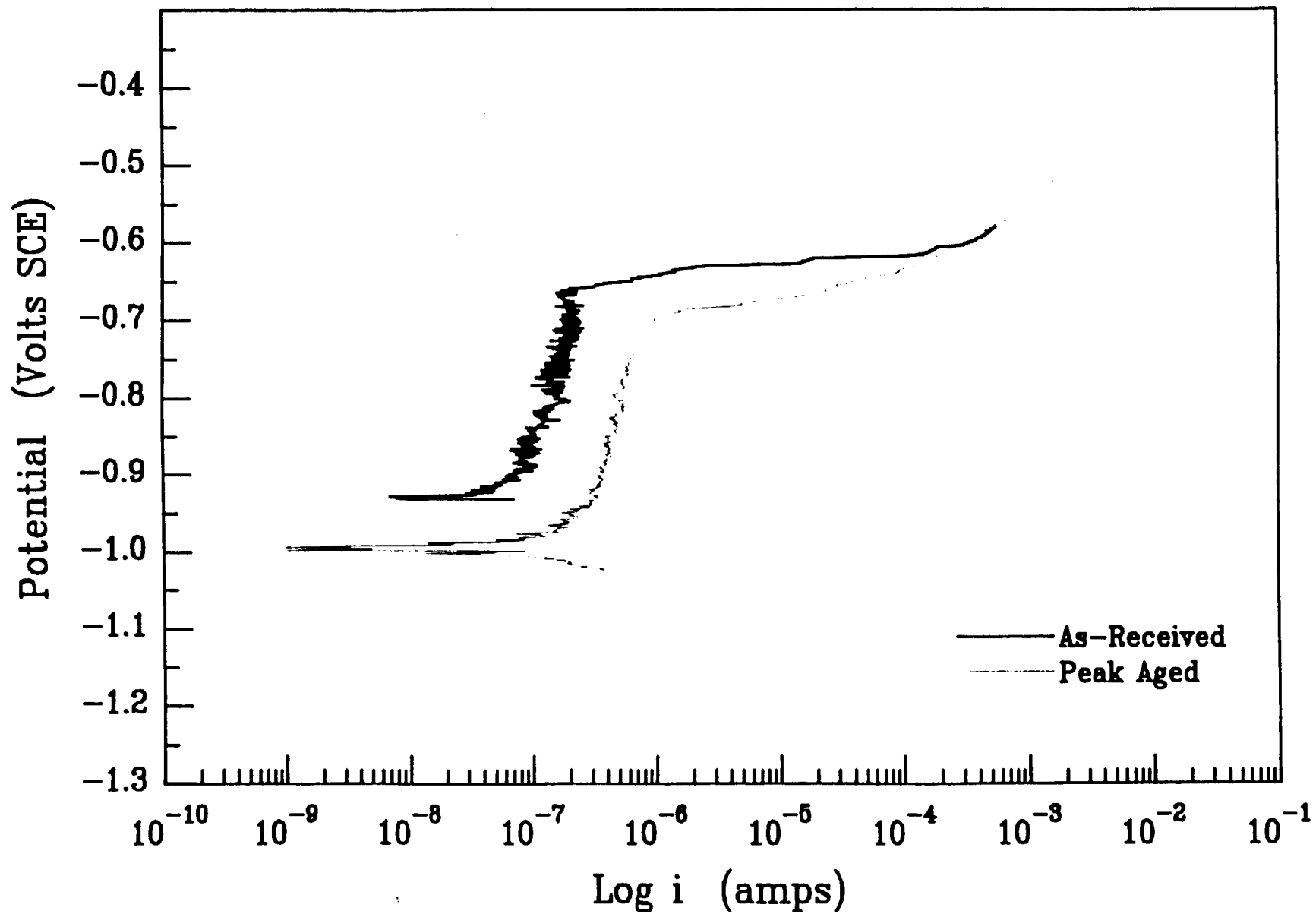


8090 + 0.0 w/o Zn

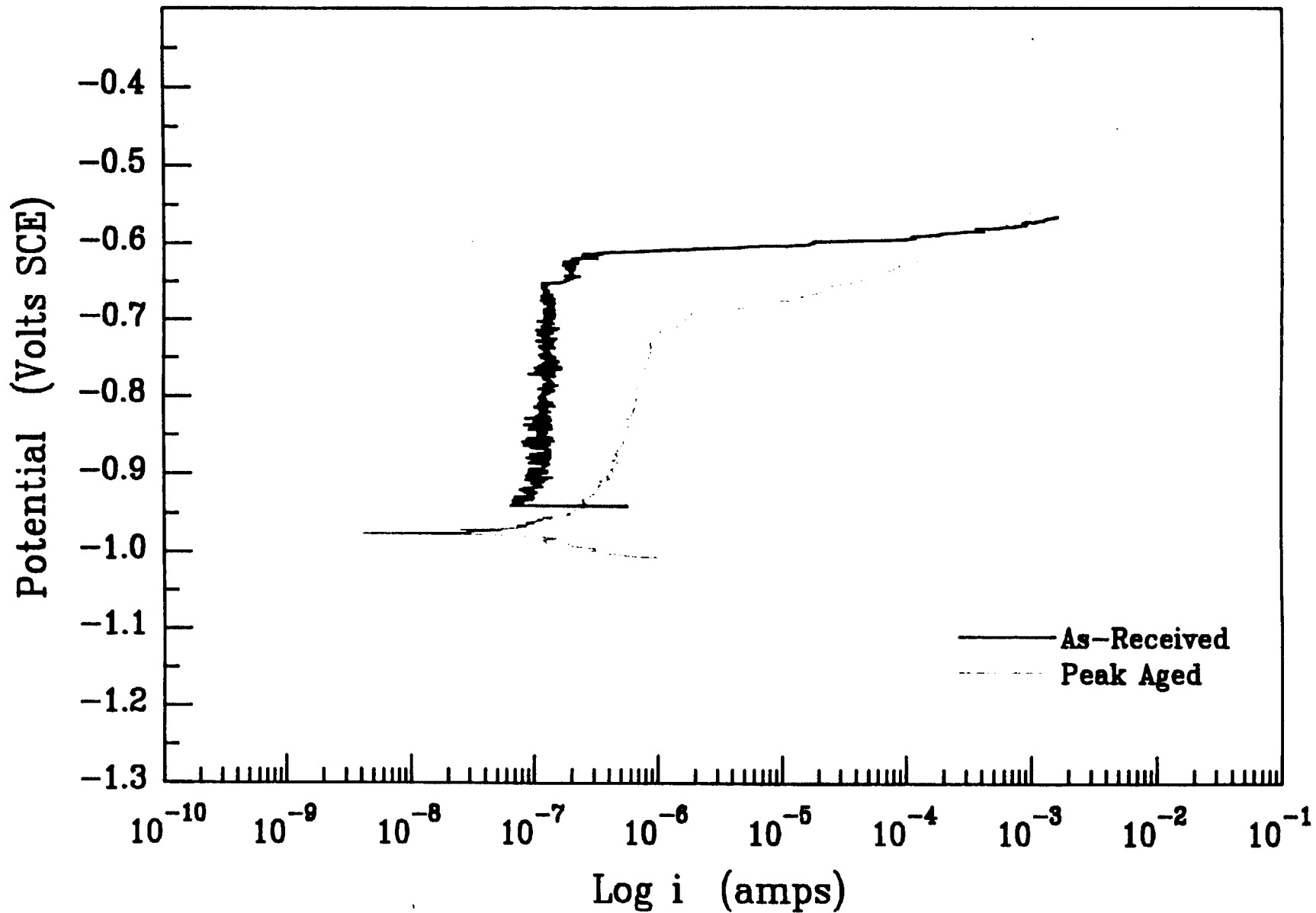
Deaerated 3.5 w/o NaCl



8090 + 0.2 w/o Zn  
Deaerated 3.5 w/o NaCl



8090 + 0.5 w/o Zn  
Deaerated 3.5 w/o NaCl



8090 + 1.0 w/o Zn

Deaerated 3.5 w/o NaCl

