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To: Prof. Ray Weiss
Physics

Ray- Here are Chris Mannings results (finally). There was no sensitization of the LIGO stainless steel, so stress corrosion cracking does not appear to be a concern although someone might want to do similar metallography on a welded specimen). Chris' concern about pitting in a saline environment is not a ~~concern of mine. We are not immersed in saline solution.~~ Hope this is helpful in calming fears.

I DON'T AGREE!

Tom

Memorandum

DATE: November 17, 1995

TO: Professor Eagar

FROM: Chris Manning

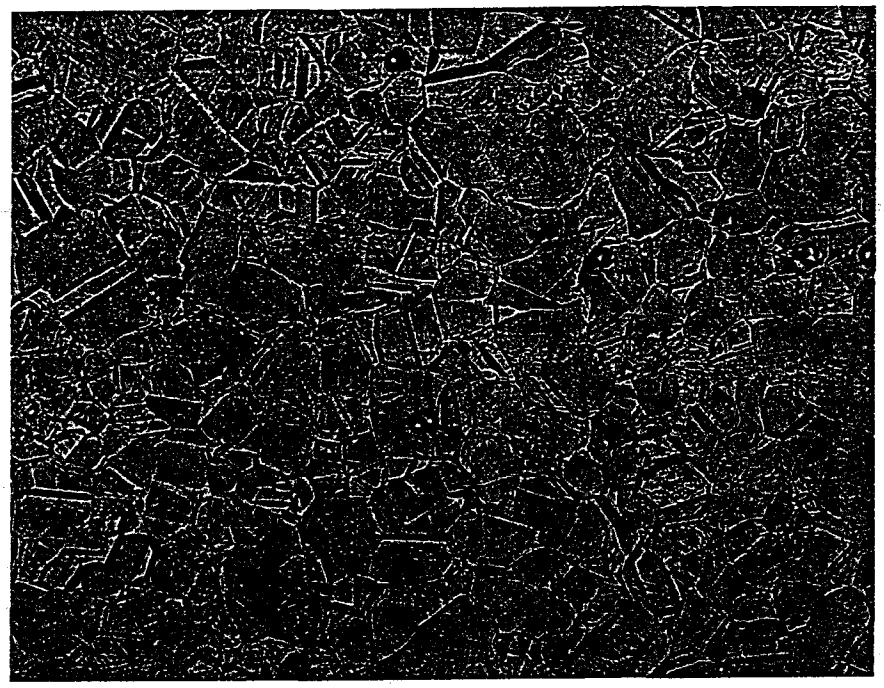
RE: LIGO 304L Stainless Steel Corrosion Tests

I performed the oxalic acid etch test (practice A, intended for screening and acceptance of material), on two specimens of the LIGO 304L stainless steel. Attached are photographs of the etched specimens. Structures observed are "step structure" and "end grain pitting"; both are acceptable etch structures.

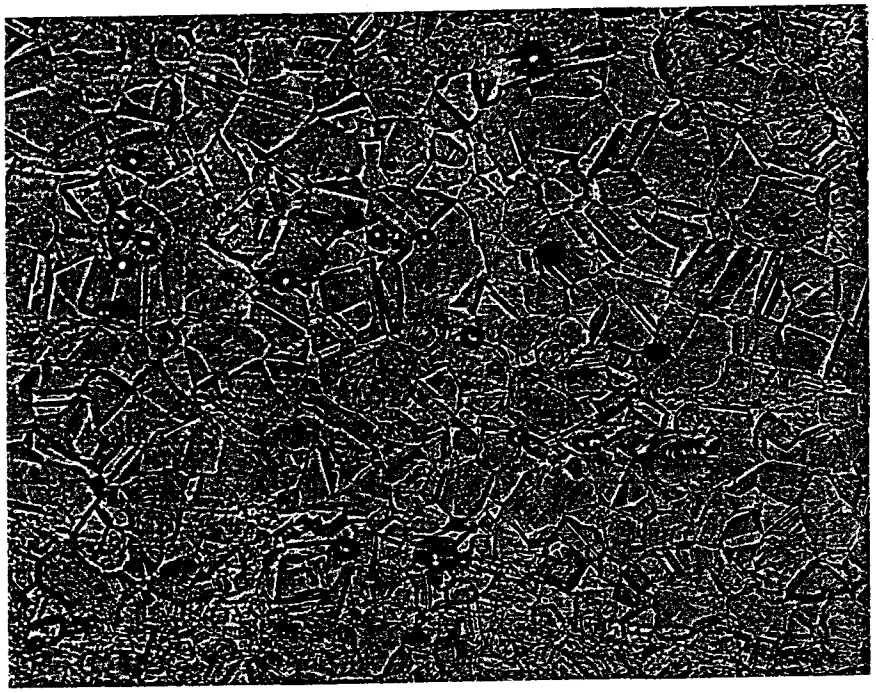
Also included is a 50x magnification photograph of the surface a polarization test specimen tested with the surface oxide removed in 0.45 % NaCl. Pitting is obviously the type of corrosion present in this chloride environment. Pitting was also observed on specimens tested with the oxide present. However, the density of pits per unit area was much lower on the oxidized specimens than on the unoxidized specimens. Fewer pits per area means a more intense reaction occurring at the pit sites. Local breaks in the thick oxide scale provide an excellent occluded region for the development of pitting/crevice corrosion. This is something I would be concerned about in a saline environment. I tried to take a photograph of an oxidized specimen to show what I'm talking about but pictures of brown just don't come out on black and white film.

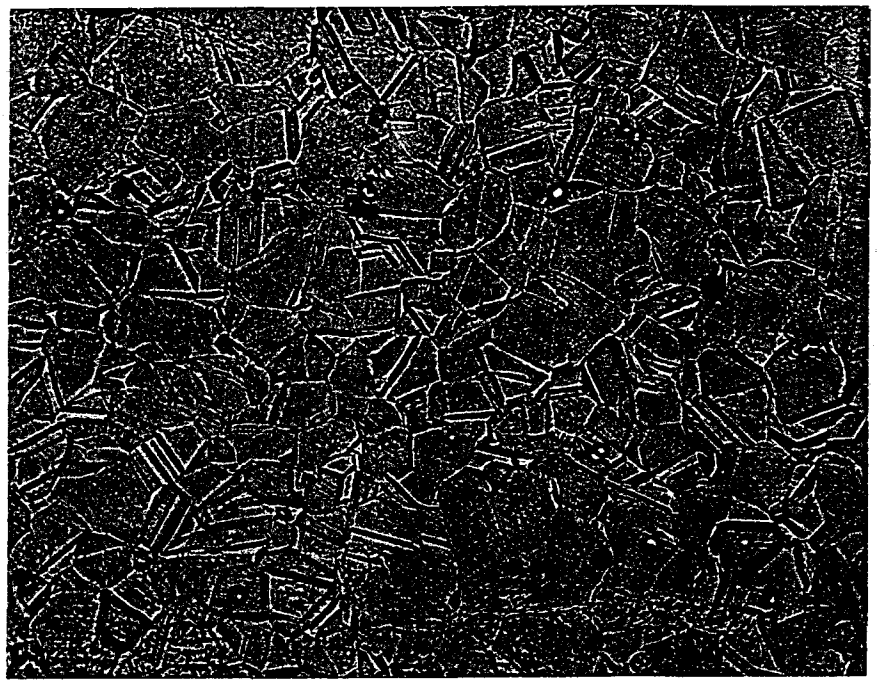
I would like to remove the oxide scale from a polarization test specimen, without removing too much metal and look at the surface compared to specimens tested without the oxide present.

APPARENTLY, SPECIMEN 1 IS UNOXIDIZED
& SPECIMEN 2 IS OXIDIZED

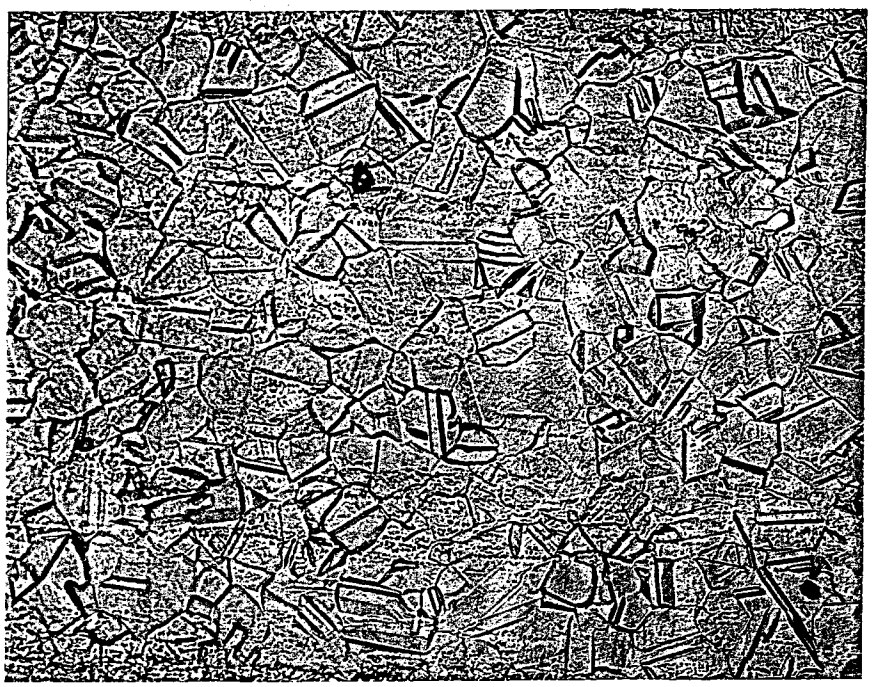


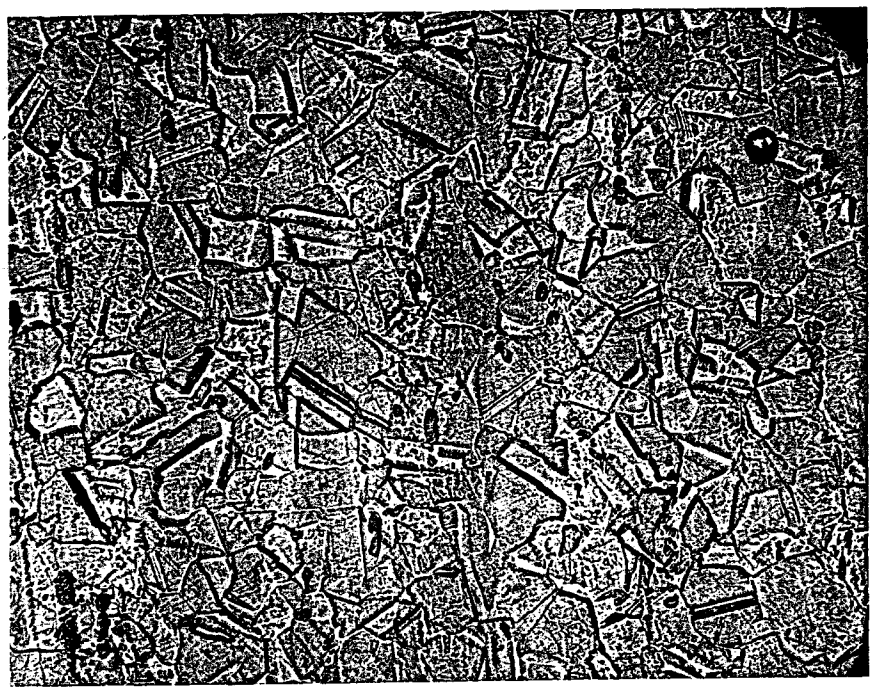
LIGO 304L Stainless Steel: Specimine 1 Oxalic Acid Etch
Step Structure + end grain pits



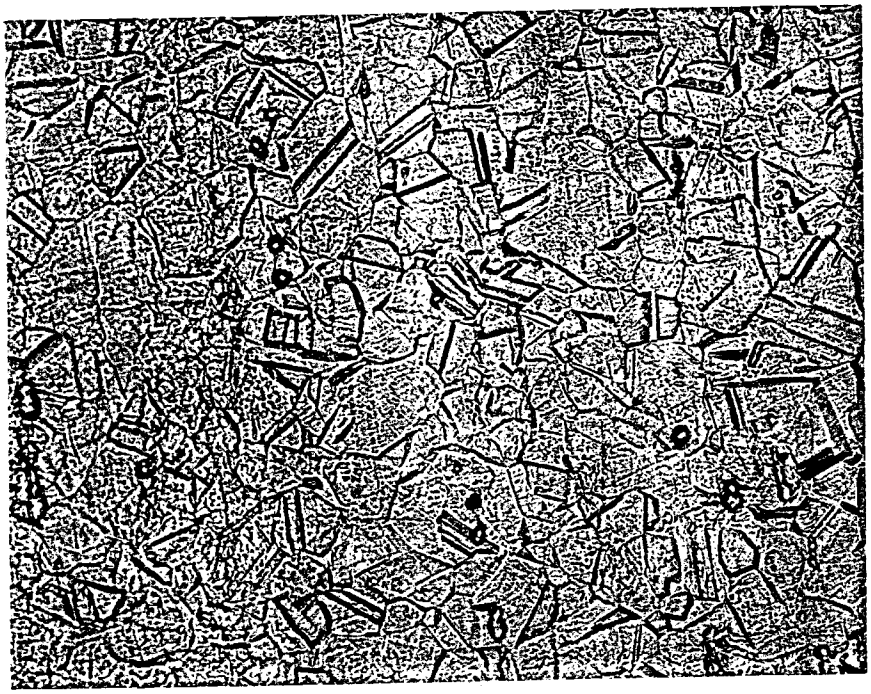


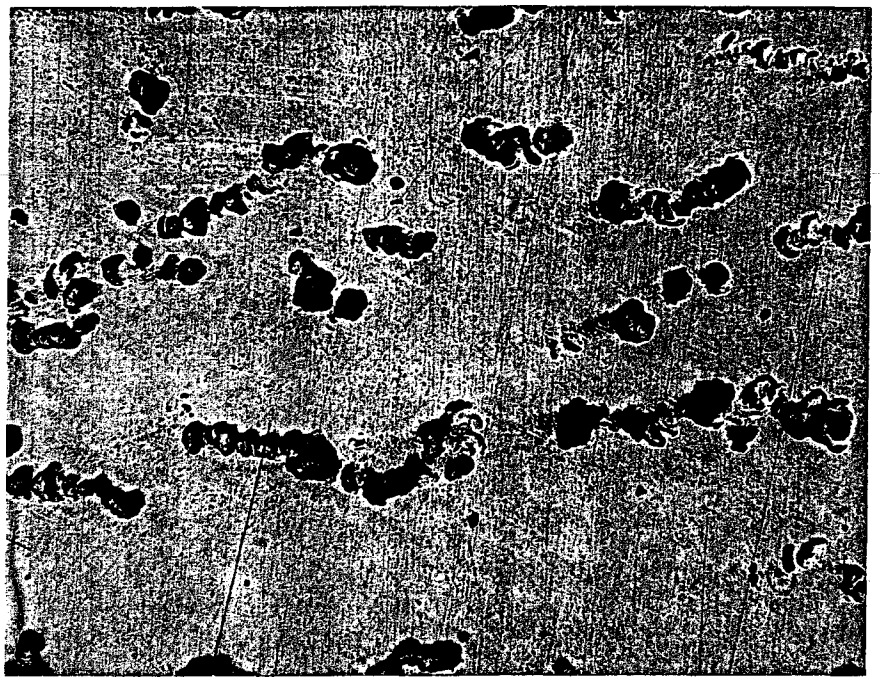
LIGO 304L SS : Oxalic Acid Etch ↑ specimen 1
Step Structure + End Grain Pits ↓ specimen 2





LIGO 304L SS: Oxalic Acid Etch : Specimine2
Step Structure + End Grain Pits





LIGO 304LSS ; Anodic Potentiostatic Polarization
0.45% NaCl, No Oxide Present
Pitting

From tweagar@MIT.EDU Mon Nov 6 05:28:11 1995
Received: from tristan.mit.edu by taliesin.mit.edu AA26146; Mon, 6 Nov 95 05:28:11 EST
Received: from MIT.EDU (SOUTH-STATION-ANNEX.MIT.EDU) by tristan.mit.edu AA06222; Mon, 6 Nov 95 05:28:10 EST
Received: from MIT.MIT.EDU by MIT.EDU with SMTP
id AA06442; Mon, 6 Nov 95 05:27:19 EST
Received: from MSHQ-MAC-24.MIT.EDU by MIT.MIT.EDU (5.61/4.7) id AA20191; Mon, 6 Nov 95 05:28:09 EST
Message-Id: <9511061028.AA20191@MIT.MIT.EDU>
Date: Mon, 06 Nov 95 06:30:56
From: tweagar@MIT.EDU (Thomas W.Eagar)
To: mog@MIT.EDU
Subject: Re: LIGO 304 stainless tests
Cc: weiss
Status: R

> From: mog@MIT.EDU
> To: tweagar@MIT.EDU
> Subject: LIGO 304 stainless tests
> Date: Sat, 04 Nov 1995 18:48:42 EST
>
> Professor Eagar,
>
> Friday night,I was able to properly etch a sample of the LIGO steel, by
> the oxalic acid etch test. Looking at the sample at 40 X it doesn't appear
> to be sensitized. I will hopefully be able to get some pictures to you by
> next Tuesday. I was wondering if you want me to take pictures of the samples
> that I collected polarization data for. If so, I was wondering if you could
> give me some advice as to how I can remove the oxide from the those samples
> I tested with the oxide present (chemicaly or mechanicaly?).

I'D LIKE TO SEE THE SAMPLES BEFORE I COMMENT ON HOW TO CLEAN THEM.

> Other testing I can do to determine susceptibility to pitting are cyclic
> polarization tests of the oxidized and unoxidized metal. To my knowledge,
> 304 stainless is susceptible to both pitting and stress corrosion cracking
> in chloride environments.

YES IT PITS BUT ONLY IN STRONGLY ACID CONDITIONS-NOT JUST SALT AIR

> Please let me know if you would like pictures of the polarization samples
> and if there are other tests you want me to do.
>
> thanks,
> Chris Manning

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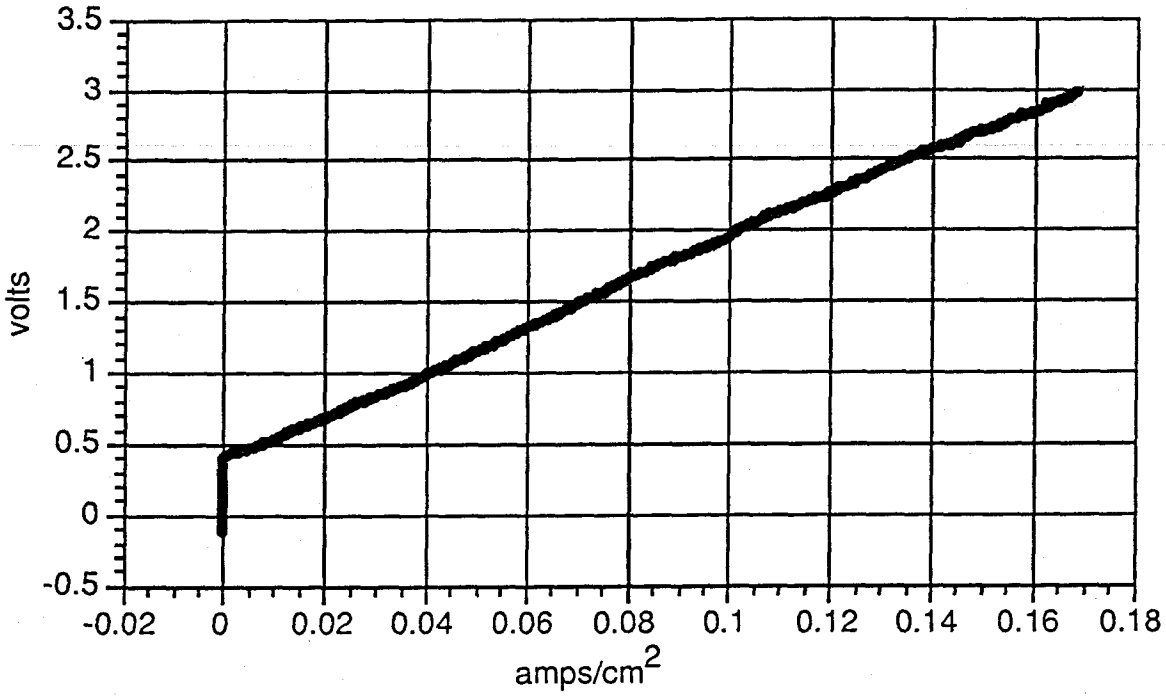
Ray –

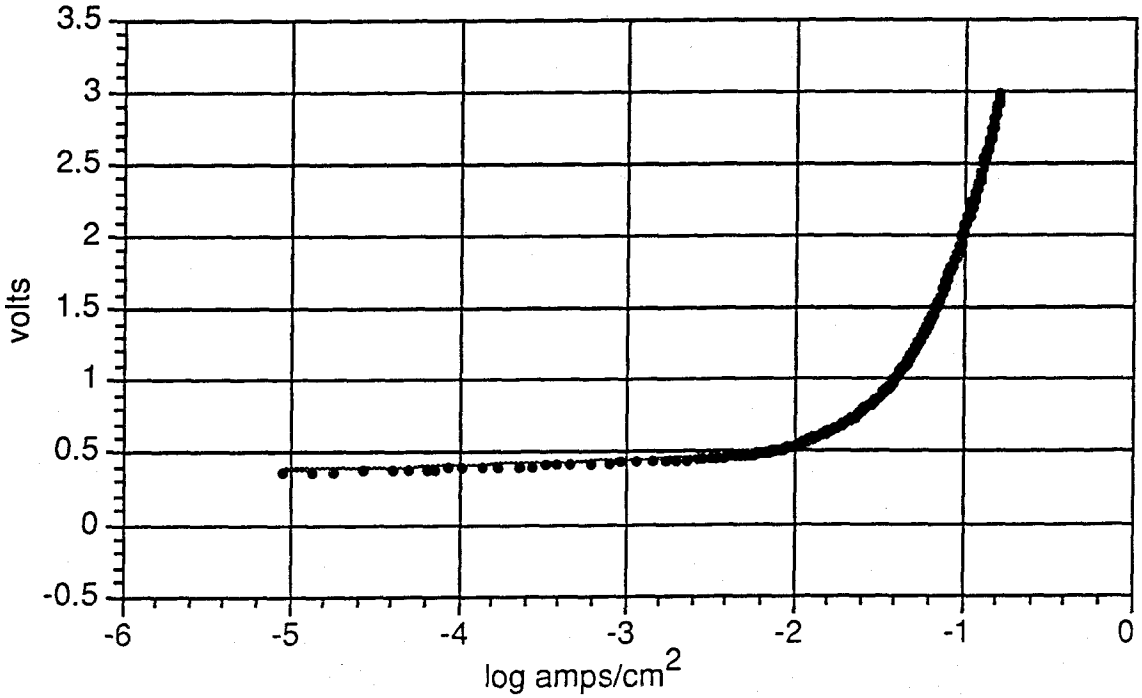
Here are the Polarization Curves for your 304 SS with and without the oxide layer. There are no substantial differences in the behavior of these samples.

GOES AGAINST DESKTOP SALT SOLN.

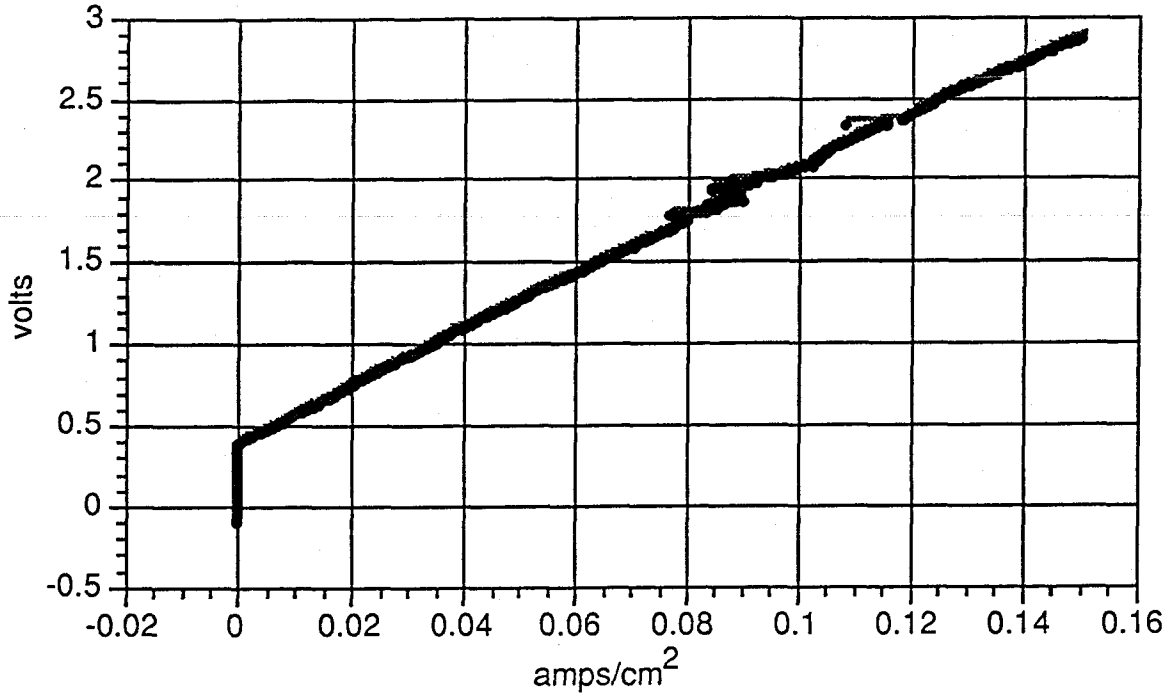
Tom

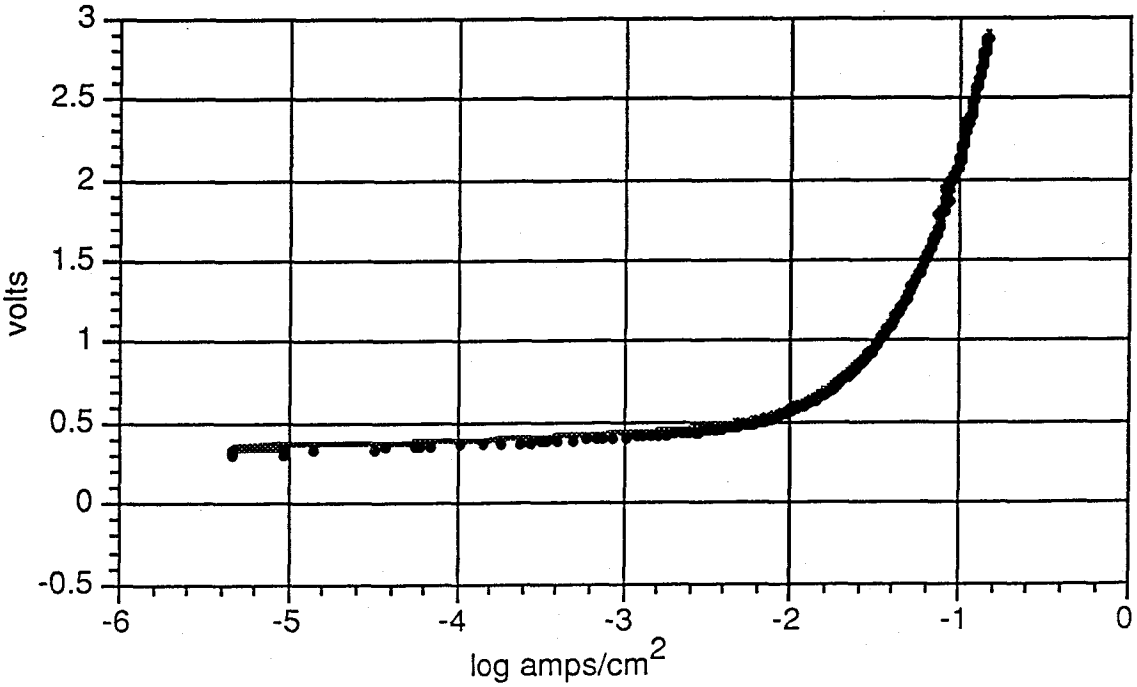
304L Stainless Steel
Polished
.45% NaCl



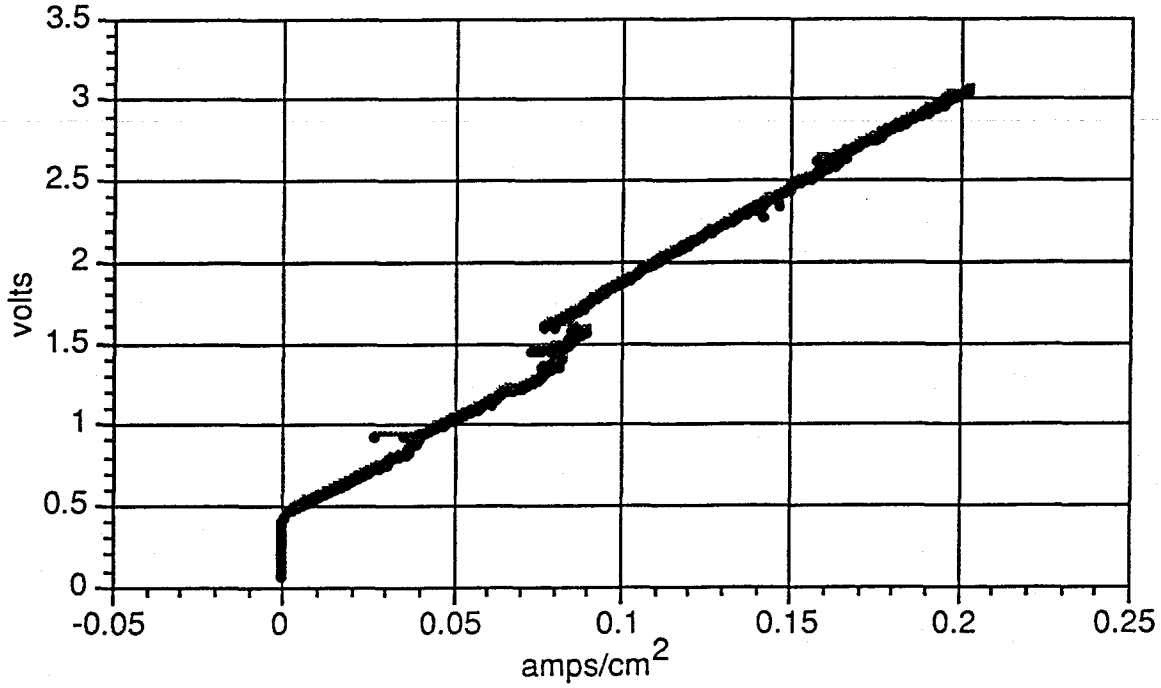


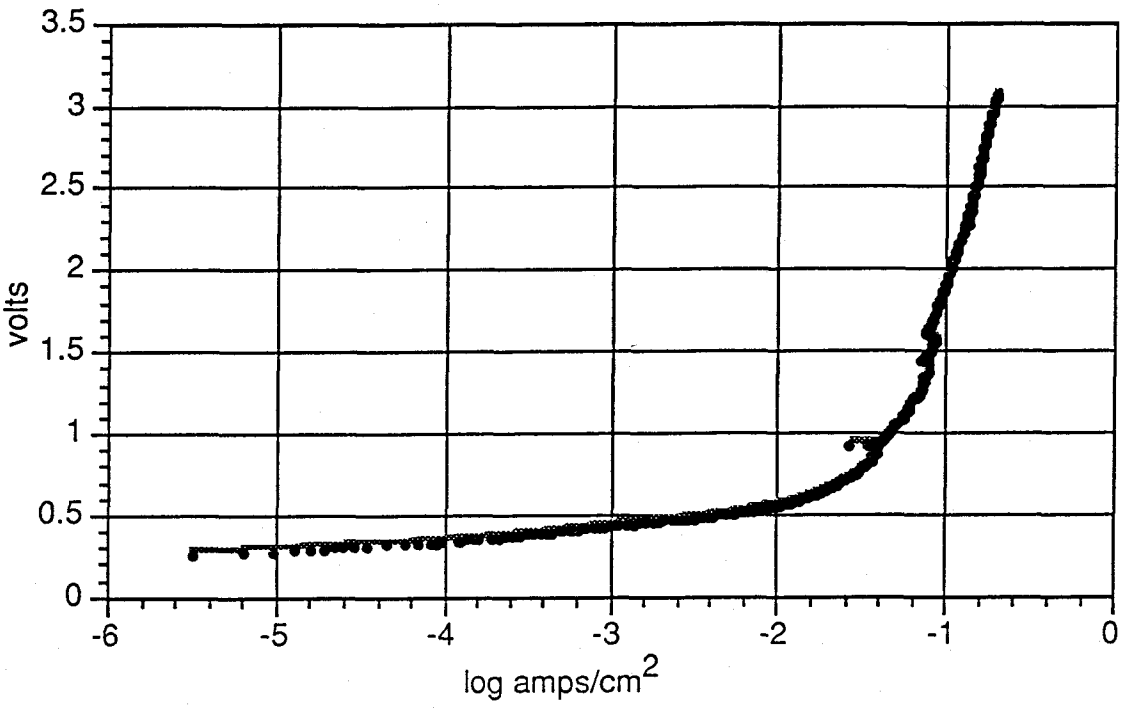
304L Stainless Steel
Polished
.45% NaCl





304L Stainless Steel
With Oxide Layer
.45% NaCl





304L Stainless Steel
With Oxide Layer
.45% NaCl