COO. 2305-2

Electron-Dislocation Interactions at Low Temperatures.

J. M. Galligan

Dept. of Metallurgy

University of Connecticut

Storrs, Connecticut 06268

Technical Progress Report.

In the present contract period, the following research has been undertaken.

A. Measurement of the change in flow stress in superconducting crystals of lead and lead-tin.

B. Studies of the change in magnetization of lead-indium crystals when dislocations move.

C. Preparation of niobium crystals of high purity and perfection.

A. Lead-tin crystals with various concentrations of tin, have been deformed at $4.2^{O}K$ and the change in flow stress from the normal state to the superconducting state measured. These findings show that the concentration of the solute is important above a concentration of 50 p. p. m. solute. We are continuing these studies, with other alloys, to see if the effect is quite general, especially to understand how the type of solute influences the elctron drag on dislocations. These experiments are being conducted by Mr. John Tregilgas and Mr. C. S. Pang.

DISCLAIMER

B. Studies of the change in magnetization in lead-indium crystals lead us to believe that mobile dislocations may be affecting the way in which flux leaves or enters a crystal, especially as the amount of hysteresis changes in a sample. We have now studied the influence of the temperature of a sample on changes in magnetization and it appears that the lower the temperature, the larger is the change in magnetization when dislocations move. This work is being conducted by John Tregilgas, C. S. Pang and J. M. Galligan.

C. Our present efforts at removing interstitials from niobium are focusing on obtaining better vacuum conditions in order to more confidently reduce the concentration of impurity interstitials in niobium. We plan to assess the removal of interstitial impurities by measuring the critical temperature of niobium and, perhaps, some internal friction measurements. This work is being carried out by Mr. Phillip Van Saun and Mr. S. Huang.

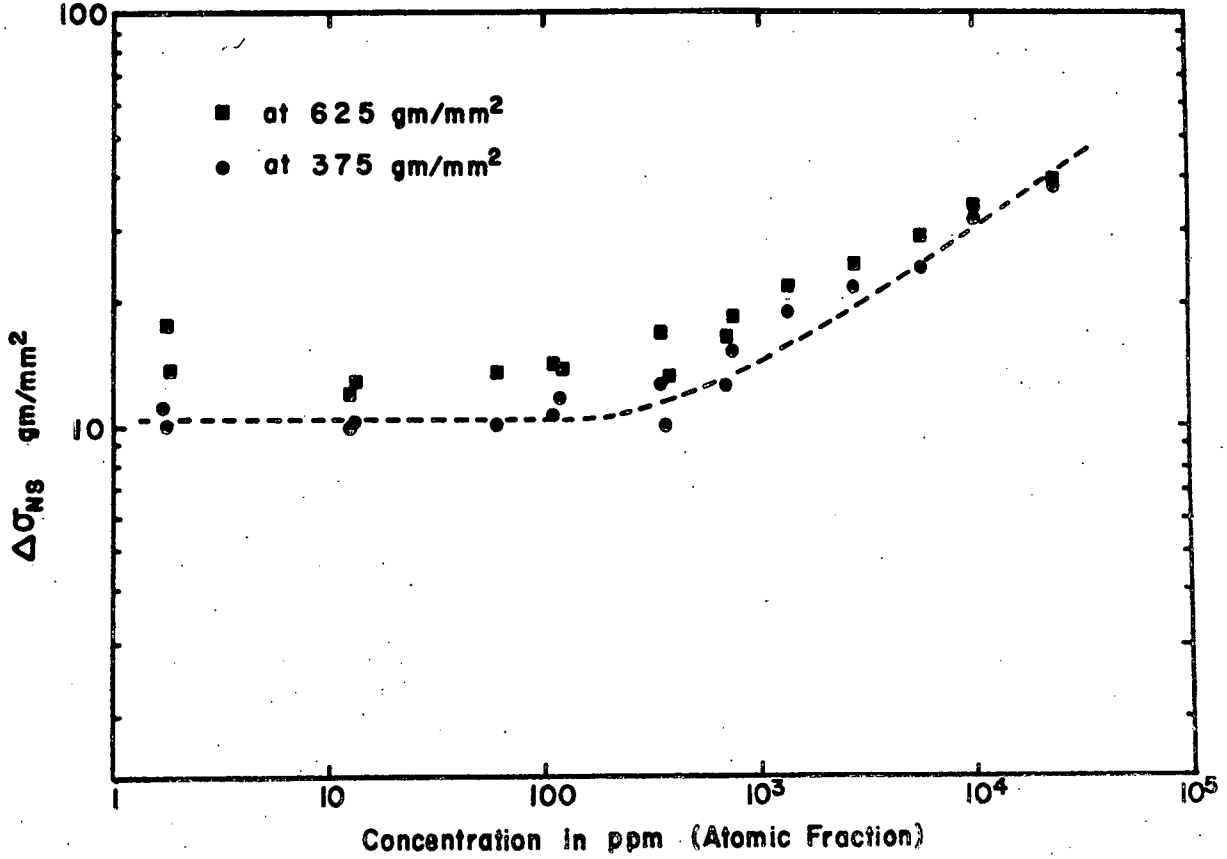
Figure Captions

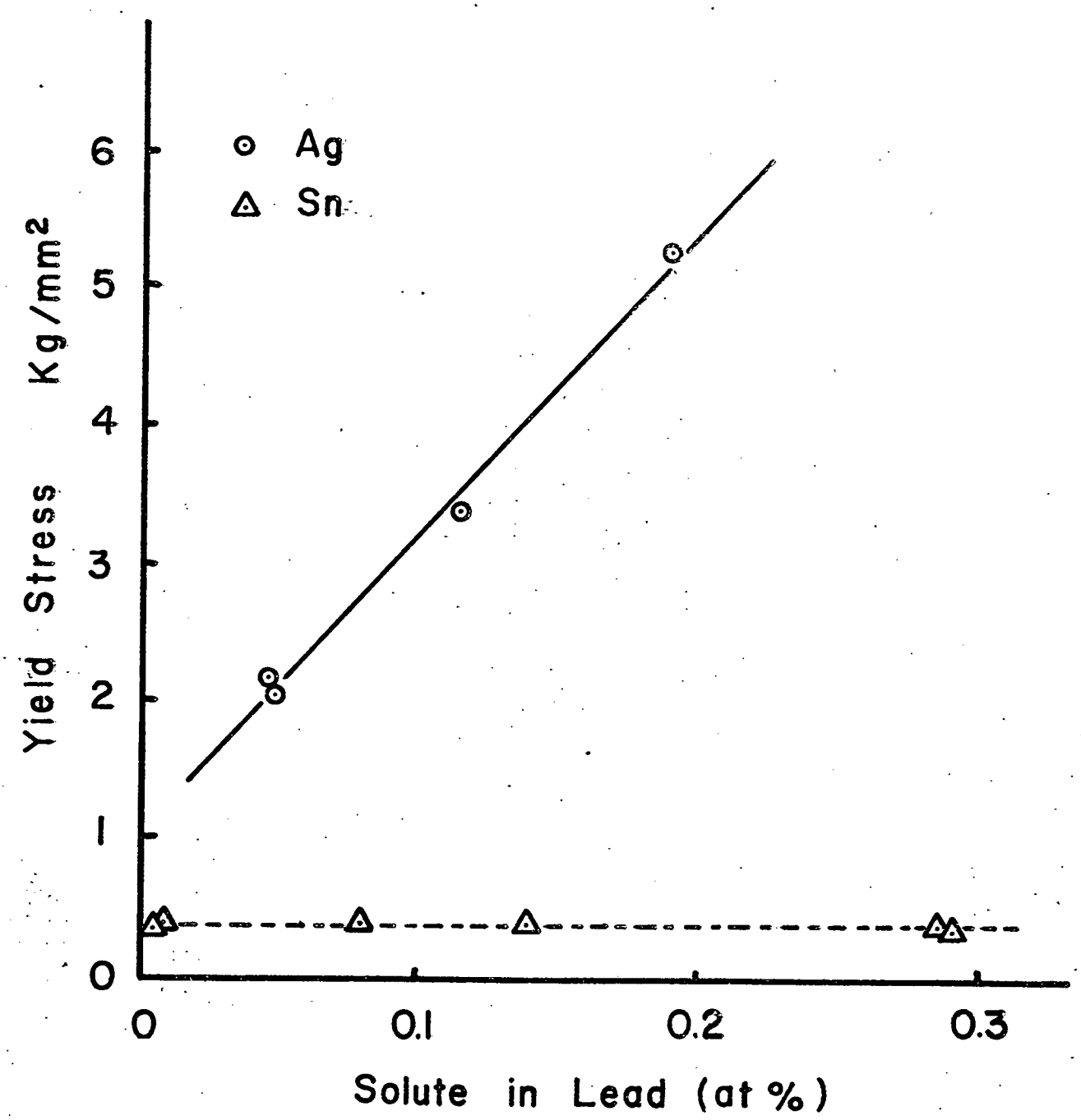
Fig. 1 The difference in flow stress between the normal state and the superconducting state, $\Delta\sigma_{NS}$, as a function of tin concentration measured at two values of applied stress.

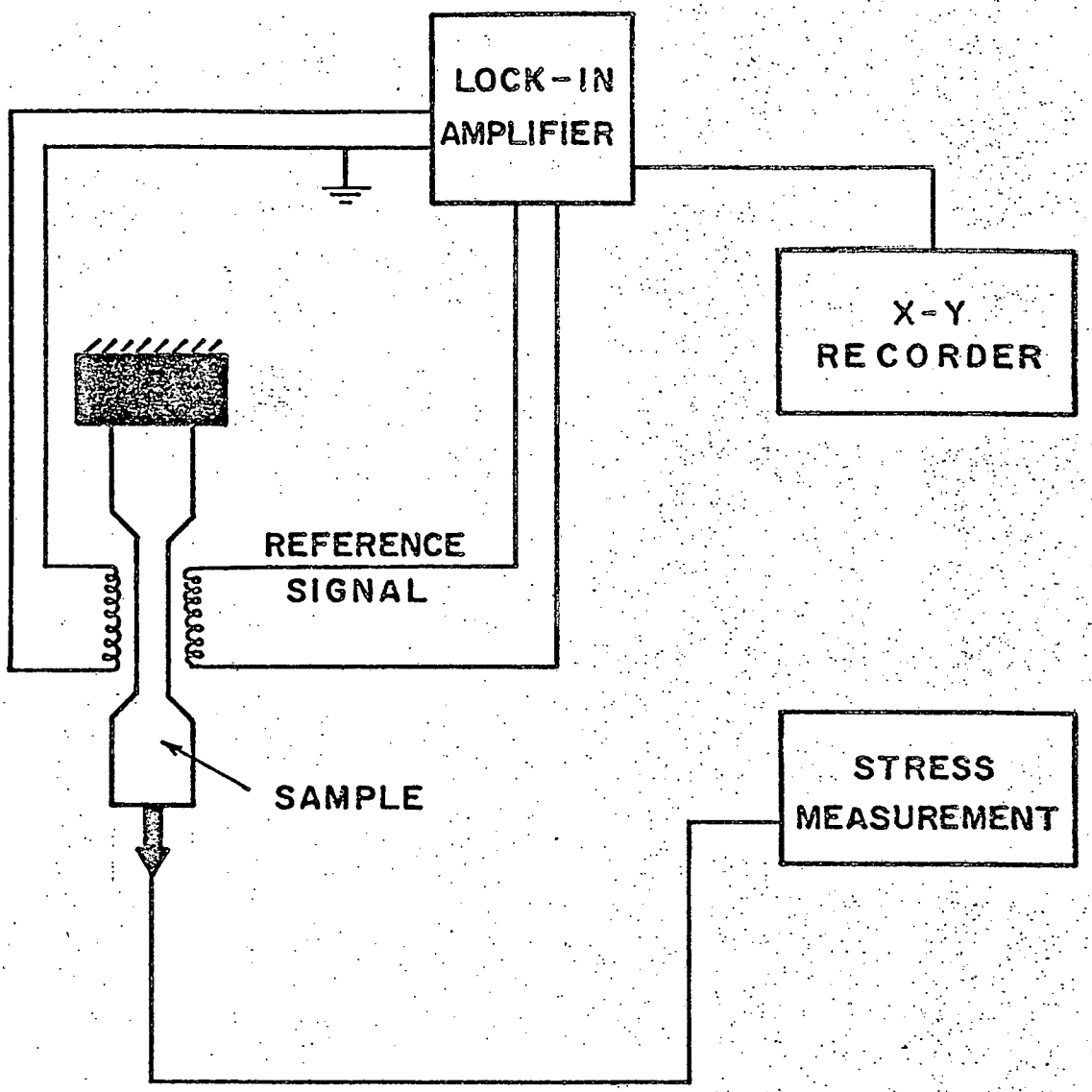
Fig. 2 The yield stress as a function of solute concentration for lead-silver and lead-tin alloys measured at 4.2°K.

Fig. 3a Circuit used in monitoring the changes in inductance of lead alloys.

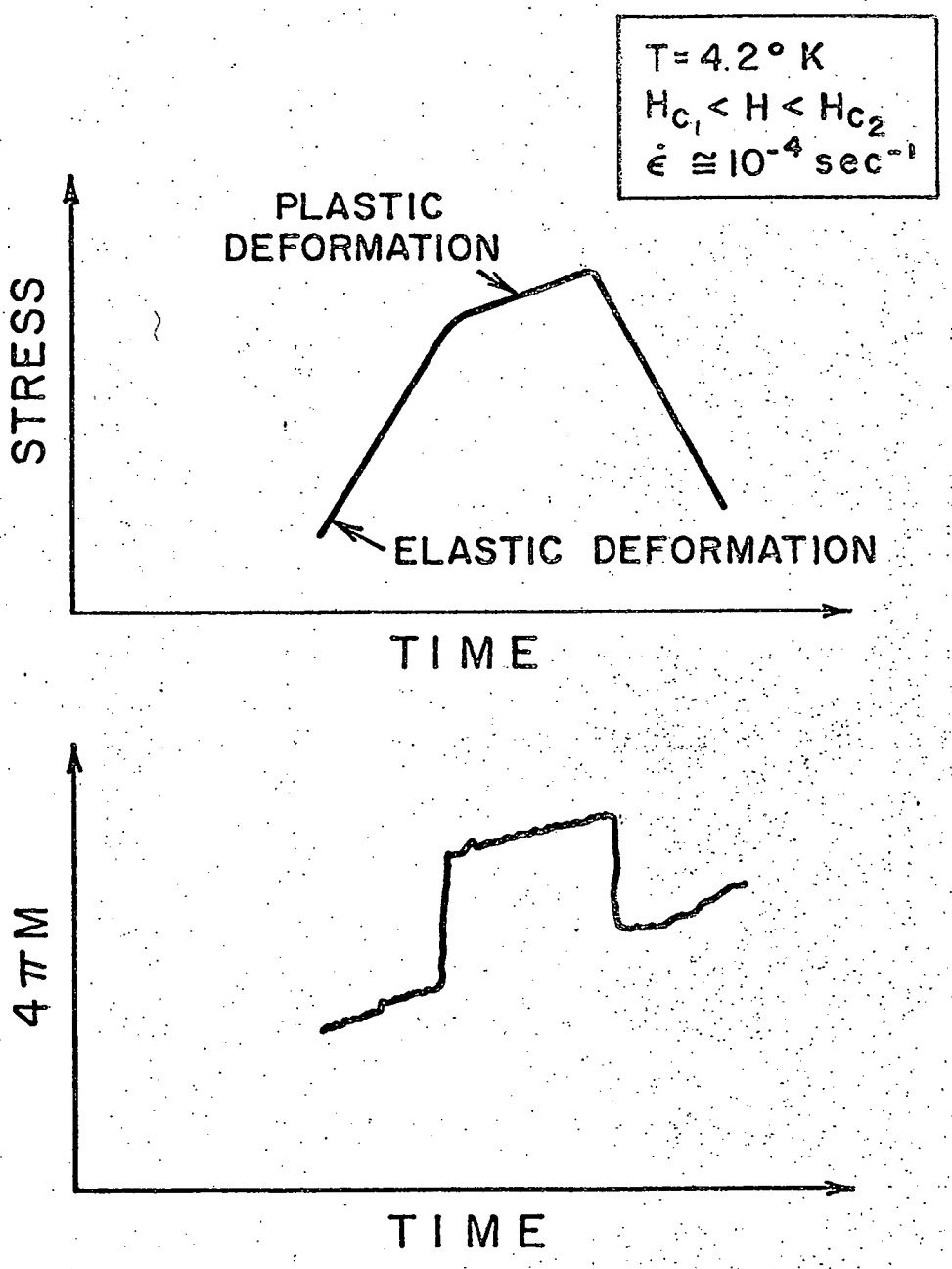
Fig. 3b The observed change in magnetization of a lead - 5 at % indium alloys which occurs with plastic deformation.


100
10
■ at 625 gm/mm²
● at 375 gm/mm²
$\Delta\sigma_{NS}$ gm/mm²
1
10
100
10³
10⁴
10⁵
Concentration in ppm (Atomic Fraction)


Ag
Sn
Yield Stress Kg/mm²
0
1
2
3
4
5
6
0
0.1
0.2
0.3
Solute in Lead (at %)



EXPERIMENTAL SETUP


T = 4.2° K
$H_{c_1} < H < H_{c_2}$
$\dot{\epsilon} \cong 10^{-4}$ sec^{-1}
PLASTIC DEFORMATION
STRESS
ELASTIC DEFORMATION
TIME
4πM
TIME