AD-A165 895 SEMICONDUCTING TRANSITION METAL SILICIDES FOR ELECTRO-OPTIC VSLI INTERCONNECTS(U) COLORADO RESEARCH DEVELOPMENT CORP FORT COLLINS J E MAHAN 15 JAN 86 1/1

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Interim Status Report No. 3

SEMICONDUCTING TRANSITION METAL SILICIDES FOR ELECTRO-OPTIC VSLI INTERCONNECTS

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PROGRESS REPORT #3

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During the period since the last progress report, we have optically characterized the $CrSi_2$ samples, and fabricated thin films of $MnSi_{1.7}$ and $IrSi_{1.75}$. X-ray analysis of the latter two silicides has also been accomplished. These developments are summarized below.

Optical Characterization of $CrSi_2$

The spectral reflectance and transmittance of a representative sample are shown in Figure 1. A forbidden energy gap of ~0.3eV is obtained from the onset of strong absorption at that energy. The interference fringes correspond to a refractive index-film thickness product of ~10 microns; the estimated film thickness of 2.4 microns gives a refractive index of approximately 4.2 below the absorption edge. The strong absorption for the film above the absorption edge indicates an absorption coefficient of approximately $3 \times 10^3 cm^{-1}$. Because of this relatively low value of absorption coefficient, we tentatively identify the forbidden energy gap as of the indirect type. Computer analysis of the data is in progress.

$MnSi_{1.7}$ Formation and Analysis

Thin films of this material were formed by ion beam sputtering and furnace reaction techniques as described for $CrSi_2$ in our first progress report. X-ray diffraction analysis of the films confirms the presence of the semiconducting manganese silicide, with no other detectable phase except the silicon substrate. A diffraction pattern for a 1.5 micron-thick film is shown in Figure 2. Peaks belonging to the semiconducting manganese silicide phase are indicated, but the pattern cannot be indexed because the crystal structure is unknown. Different textures were observed for the three substrate types (1-0-0 and 1-1-1 silicon, and polysilicon-coated wafer).

The room temperature resistivity of the material is 0.04 ohm-cm. Samples formed at 1000C exhibit a photoconductivity, upon illumination with a 6V microscope lamp, of about 0.04% of the dark conductivity. Preliminary transmittance measurements indicate a bandgap somewhat larger than that of the chromium disilicide.

$IrSi_{1.75}$ Formation and Analysis

A representative X-ray diffraction pattern for a film formed at 750C is shown ~~in Figure 3.~~ Again, the data indicate the well-crystallized semiconducting silicide phase and no other except for the silicon substrate.

The room temperature resistivity for this material is on the order of 0.15 ohm-cm, with a photoconductivity as measured above of about 0.3% of the dark conductivity. Preliminary transmittance measurements also indicate a bandgap somewhat larger than that of the chromium disilicide.

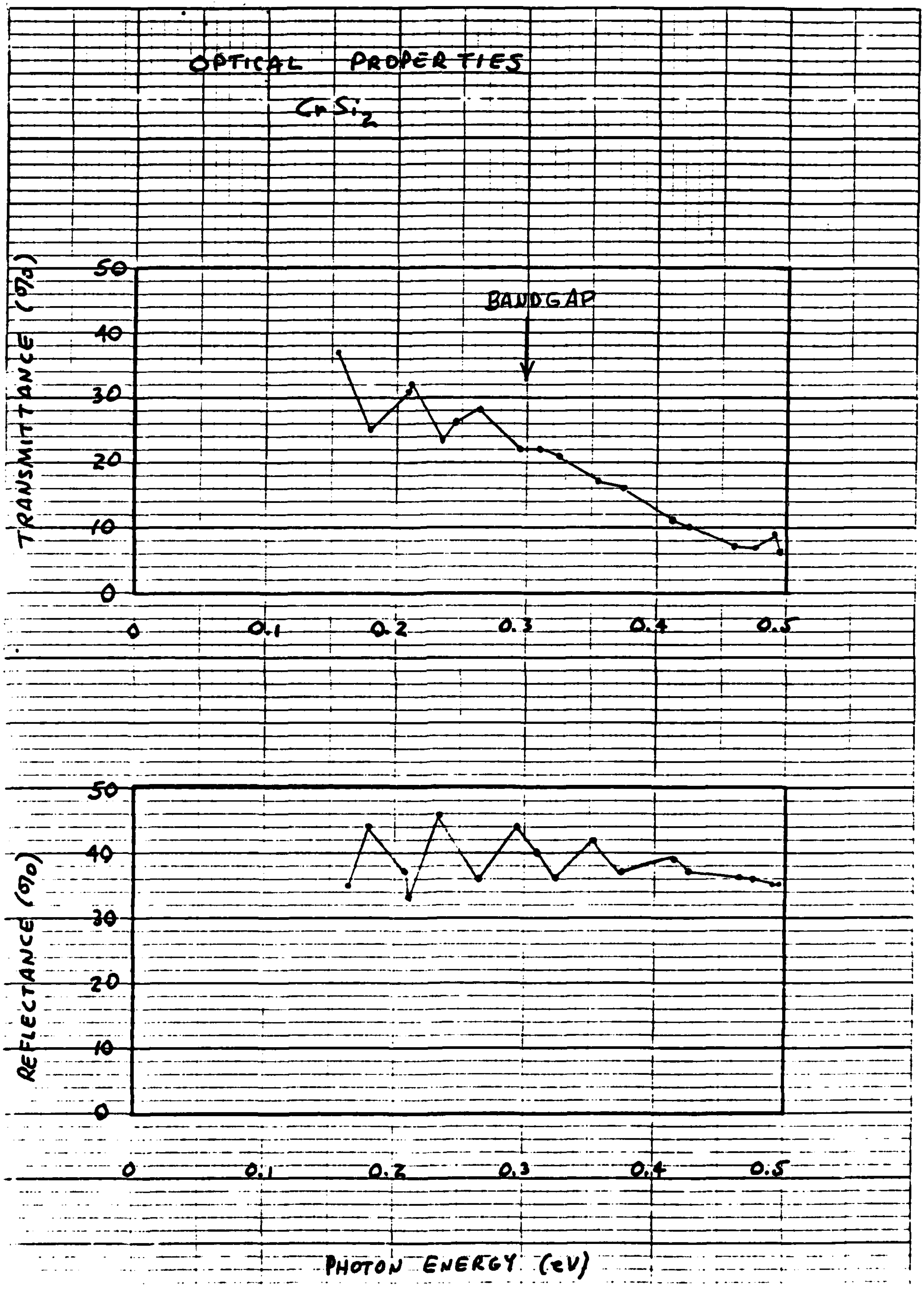
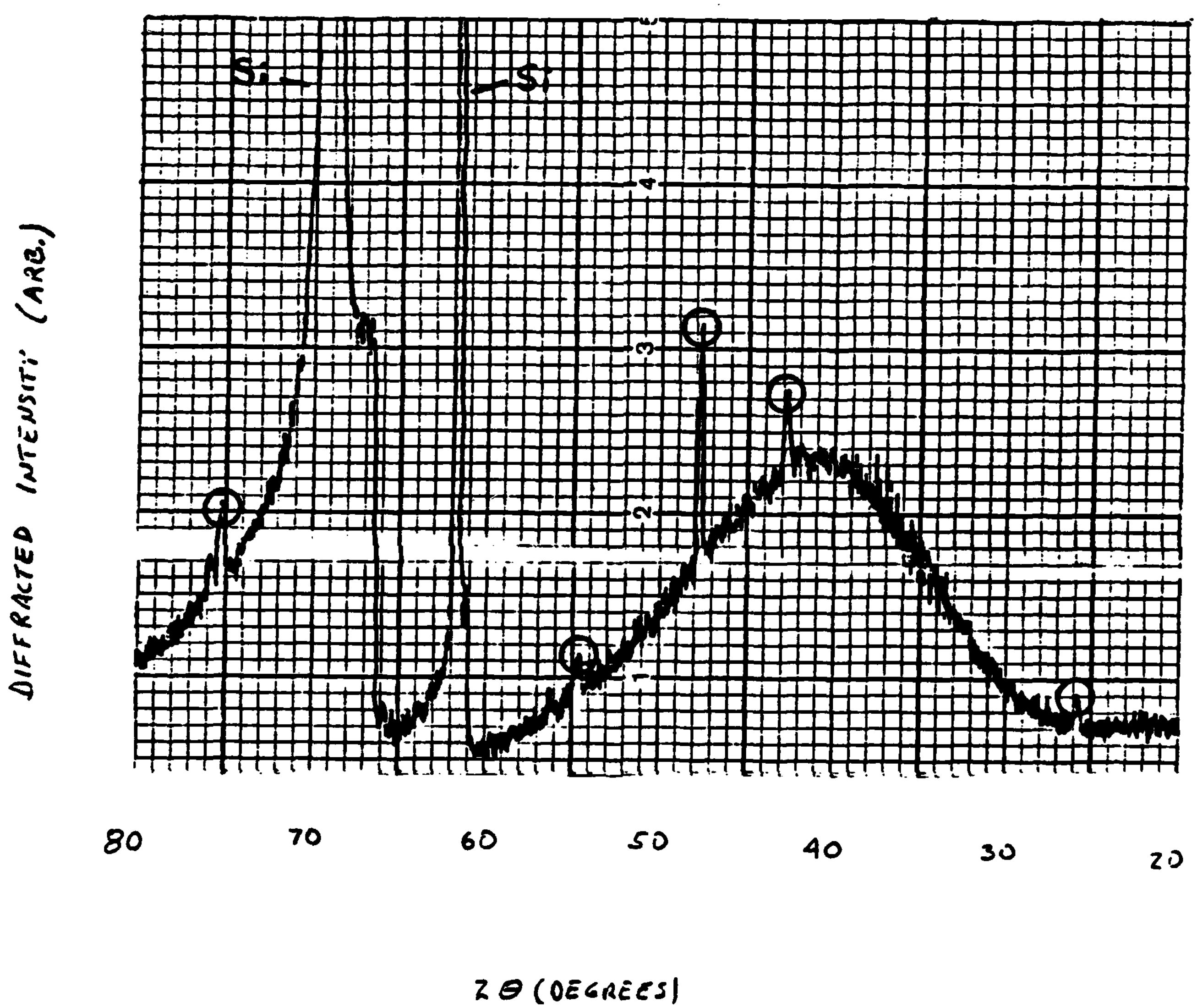

OPTICAL PROPERTIES
CrSi2
BANDGAP
TRANSMITTANCE (%)
50
40
30
20
10
0
0
0.1
0.2
0.3
0.4
0.5
REFLECTANCE (%)
50
40
30
20
10
0
0
0.1
0.2
0.3
0.4
0.5
PHOTON ENERGY (eV)

FIGURE 1

X-RAY DIFFRACTION PATTERN

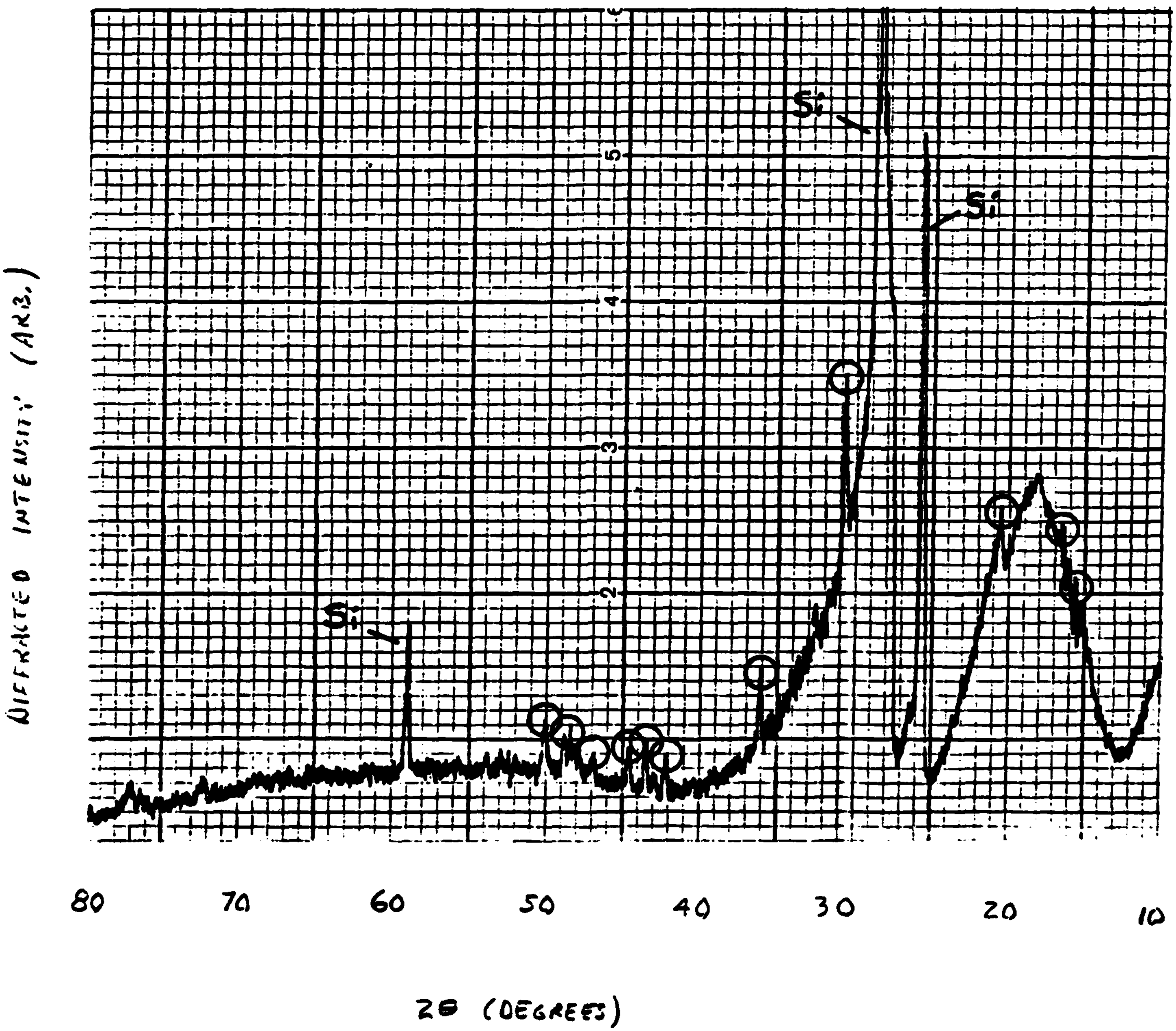
MANGANESE SILICIDE



($MnSi_{1.7}$ peaks are circled)

Figure 2

X-RAY DIFFRACTION PATTERN
IRIDIUM SILICIDE



($IrSi_{1.75}$ peaks are circled)

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