

PROCESSING

N87-16419

AMORPHOUS DIFFUSION BARRIERS

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Amorphous W-Zr Barrier

MOTIVATION

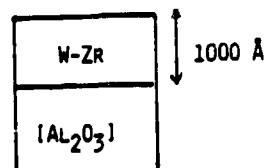
(PREVIOUS STUDIES: NI-W, NI-MO, CU-TA)

- SUBSTITUTE NI WITH ZR TO AVOID INTERFACIAL PENETRATION OF NI INTO SI SUBSTRATE AT LOW TEMPERATURES ($\sim 400^{\circ}\text{C}$)

NOTE:

- I) NI REACTS WITH SI AT $\sim 200^{\circ}\text{C}$
- II) NI IS THE MOVING SPECIES IN NI+SI REACTION
- III) ZR REACTS WITH SI AT $\sim 700^{\circ}\text{C}$
- IV) SI IS MOVING SPECIES IN ZR+SI REACTION

Crystallization

ANNEALED $500-900^{\circ}\text{C}$ (30')

X-RAY

 $T_c \sim 900^{\circ}\text{C}$

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Experimental

RF SPUTTER DEPOSIT W-ZR FILMS FROM A W TARGET
COVERED WITH ZR STRIPES IN 10MTORR AR
(BASE PRESURRE < 1E-6 TORR)

2 COMPOSITIONS: W₇₀ZR₃₀

W₄₀ZR₆₀

DEPOSITION RATE: ~ 400 Å / MIN

PL DEPOSITION WITHOUT BREAKING VACUUM ~120 Å / MIN

ANNEALING IN VACUUM: PRESSURE < 5E-7 TORR

ANALYSIS:

XPS (ATOMIC DEPTH PROFILES)

SEM, EDAX (SURFACE MORPHOLOGIES)

X-RAY (PHASE IDENTIFICATION)

N⁺P Shallow Junctions

JUNCTION DEPTH : 0.35 UM

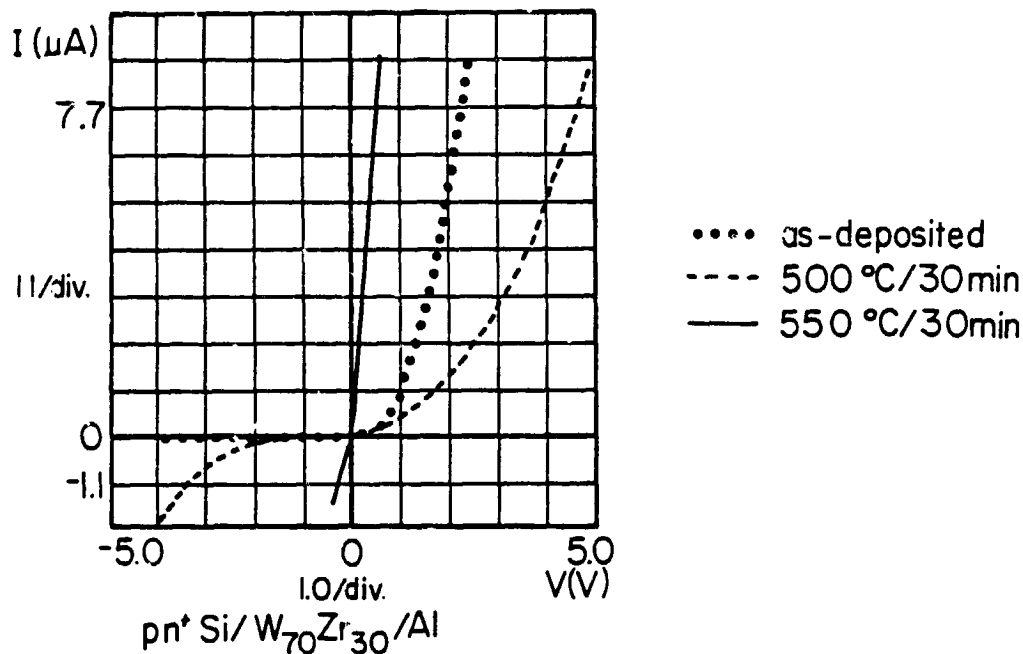
JUNCTION AREA : 500 x 500 UM²

CONTACT AREA : 300 x 300 UM²

AS SURFACE CONCENTRATION : 3E20 CM⁻³

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I-V Characteristic of n^+p Solar Cell with W-Zr Diffusion Barrier



Behavior of W-Zr Diffusion Barrier

1) INTERDIFFUSION IN [Si]/ W-Zr / Al SETS IN

AT ~ 500°C DESPITE T_c IS AS HIGH AS 900°C

(Al+W 500°C

Al+Zr 400°C)

2) REACTION BETWEEN AL AND Zr-W IS LATERALLY

NONUNIFORM ---PITS FORMATION

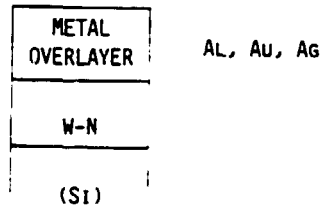
** W-Zr CANNOT BE USED AS SACRIFICIAL BARRIER

** W-Zr EFFECTIVE BELOW 500°C

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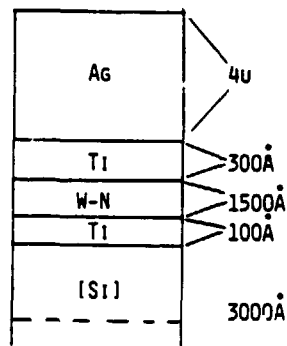
W-N Barriers

PREVIOUS WORK:

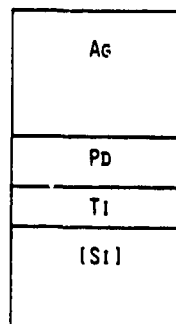


- W-N INHIBITS INTERDIFFUSION BETWEEN METAL OVERLAYER AND Si UP TO:
 - 550°C - 30 MIN. FOR AL
 - 800°C - 30 MIN. FOR AU
 - 700°C - 30 MIN. FOR Ag

Experimental: Solar Cell with W-N Diffusion Barrier



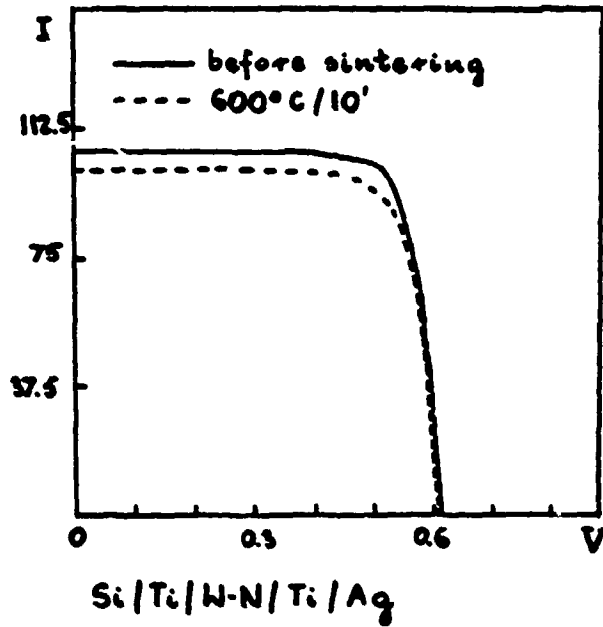
Experimental: Solar Cell with Ti-Pd-Ag Metallization



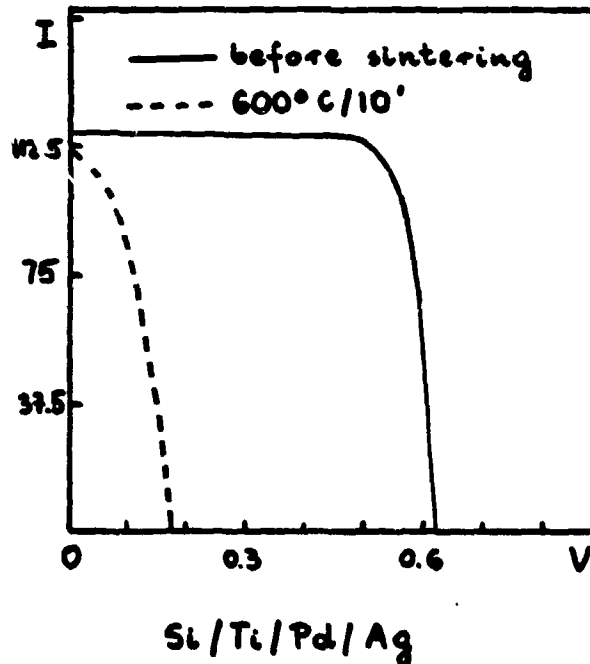
- ANNEALED IN FORMING GAS AT 400°C, 600°C FOR 10 MIN.
- I-V MEASURED UNDER AMO ILLUMINATION AT R.T.

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I-V Characteristic of n^+p Solar Cell with W-N Diffusion Barrier Under AMO Illumination at Room Temperature

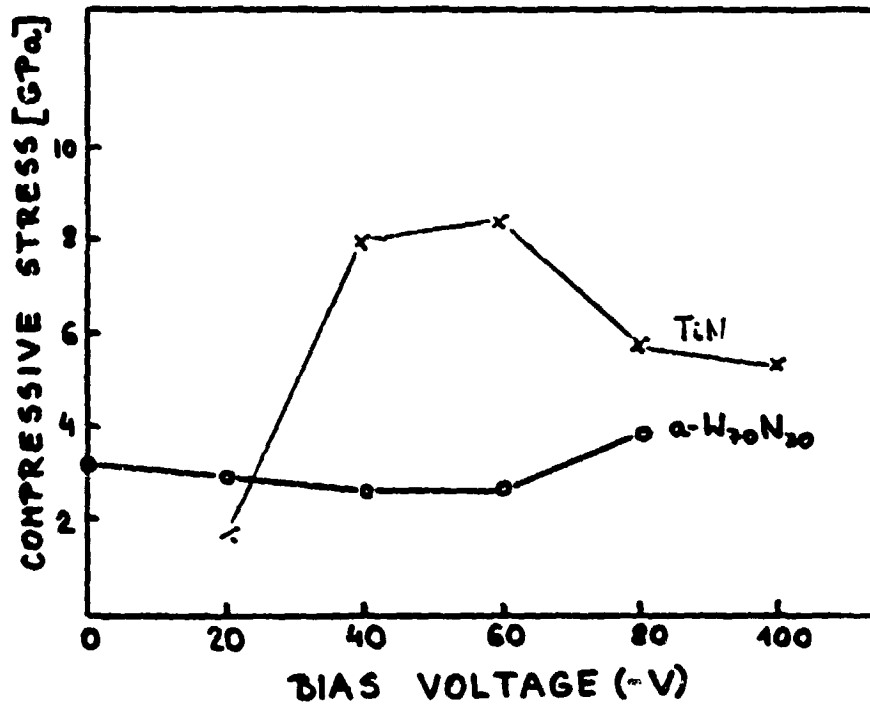


I-V Characteristic of n^+p Solar Cell with Ti-Pd-Ag Metallization



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Comparison Between Intrinsic Stress Properties of Magnetron-Sputtered TiN and α -W-N Films



Conclusions

- 1) W-Zr, Ni-W, Ni-Mo
 - FAILURE MECHANISM - REACTION WITH METAL OVERLAYER BELOW T_c
 - NEED TO FIND WAYS TO SUPPRESS THIS REACTION (E.G. NiW)
- 2) WN
 - EFFECTIVE BARRIER BETWEEN Ag } AND Si UP TO $\left\{ \begin{array}{l} 550^\circ\text{C}/30' \\ 700^\circ\text{C}/30' \\ 800^\circ\text{C}/30' \end{array} \right.$
AL }
Au }
 - STABLE Si/Ti/WN/Ag CONTACT TO SOLAR CELLS UP TO $600^\circ\text{C}/10'$
 - LOWER STRESS W-N FILMS CAN BE PRODUCED BY APPLYING NEGATIVE SUBSTRATE BIAS VOLTAGE