

Figure (4)
Before sintering

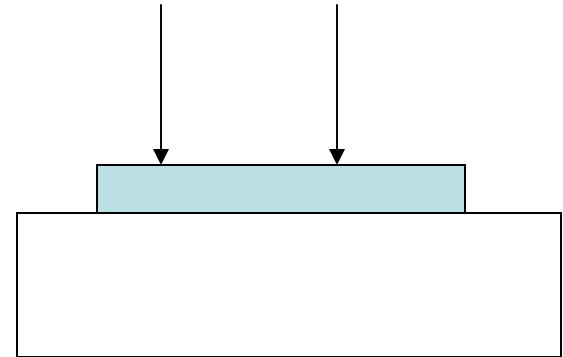
Tip position	1	2	3
Resistance	3.7 Ω	48 Ω	110 Ω
Tips Distance	~4mm	~4mm	~8mm

After sintering

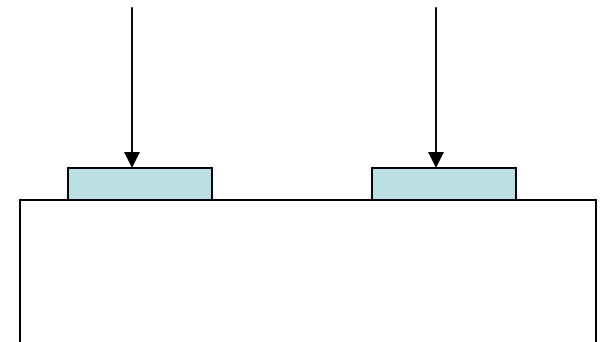
Tip position	1	2	3
Resistance	3.6 Ω	700 Ω	2400 Ω
Tips distance	~4mm	~4mm	~8mm

Table (1)

Position 1



Positions 2 and 3



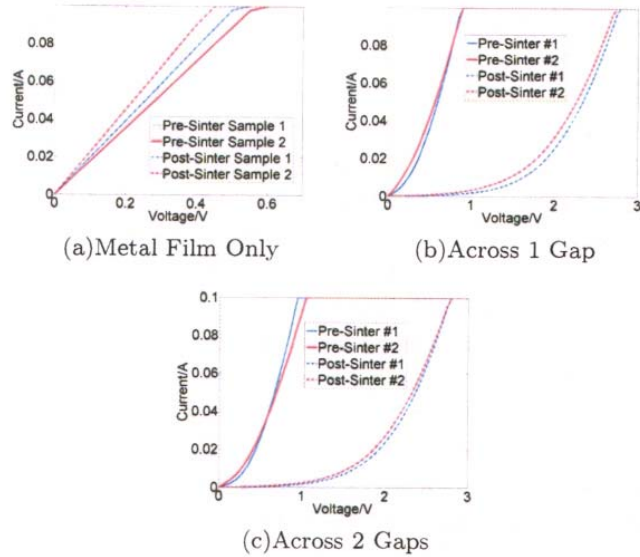


FIG. 3: 2-Probe Resistance Measurements. These are 2-probe IV curves across the right-hand horizontal metal trace in 1 (3(a)), across one silicon gap as measured between an endpoint and the middle of the blue line in Figure 1(a) (3(b)), and across both silicon gaps as measured at the endpoints of the blue line in Figure 1(a) (3(c)).

Resistance (Resistivity)	Al-Si-Al (Channel-Channel)	Al-Si-Al (Square to Channel)	Al-Al (Film)
Before Sintering	29 Ohms	152.4 Ohms	6.9 Ohms ($4.16 \cdot 10^{-8}$ Ohms-m)
After Sintering	151 Ohms	449 Ohms	7.3 Ohms ($4.40 \cdot 10^{-8}$ Ohms-m)

Short Rectangle (Length = 2600 μm)	Sample 1	Sample 1 Sintered	Sample 2
Resistance	(3.1 Ω)	2.75 Ω (1.9 Ω)	3.24 Ω (2.6 Ω)
Width	513 μm	513 μm	507 μm
Thickness	0.2 μm	0.2 μm	0.2 μm
<u>Resistance</u> (Square*Thickness in μm)		0.542 $\Omega/(\square)$	0.633 $\Omega/(\square)$
Resistivity (2.82E-8 $\Omega\text{-m}$)		1.1E-7 $\Omega\text{-m}$	1.3E-7 $\Omega\text{-m}$

Table 1: Measured and calculated resistance data for small aluminum rectangle. Data in parenthesis is from ohm-meter

Aluminum only

- small change in R after sintering
- resistivity 10x 'quoted' values
- 500 microns by 2.6 mm

How much of a change in Al resistivity would you expect to see, after sintering?

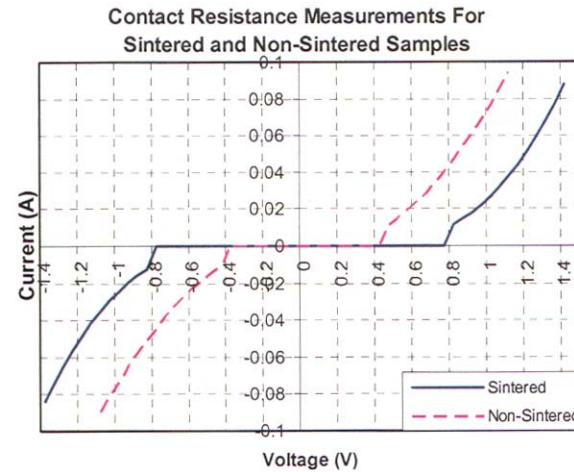
Suppose resistivity started at 10^{-5} ohm-cm
Decreased by a factor of 5 to 5×10^{-6} ohm-cm

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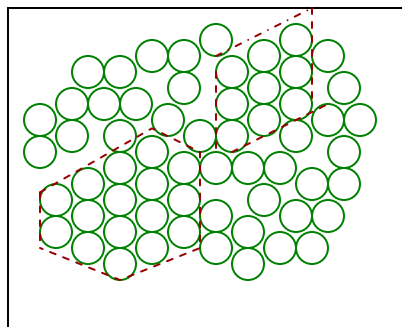
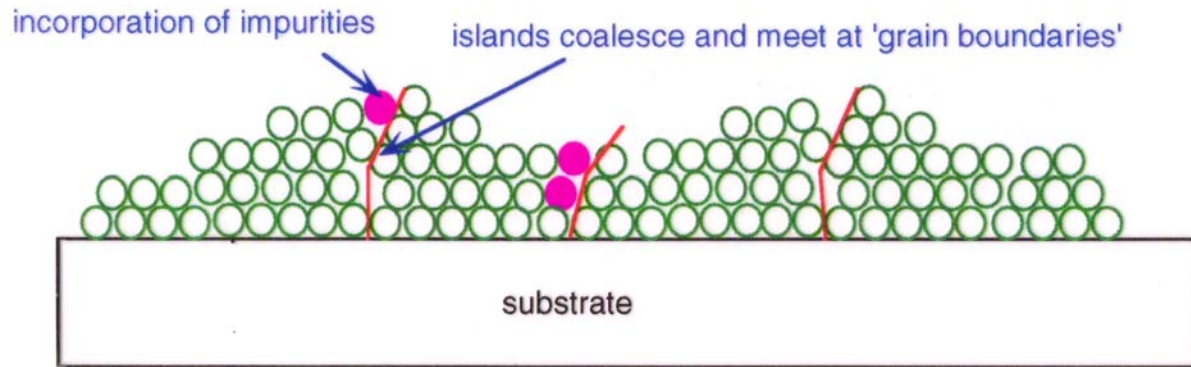
Graph 2: V-I curve between adjacent squares through silicon

Square to Square (Seperation = 3300 μm)	Sample 1	Sample 1 Sintered	Sample 2
Resistance	n/a (288 Ω)	5.86 Ω (650 Ω)	6.79 Ω (130 Ω)
Silicon Thickness	520 μm	520 μm	520 μm
Contact offset Voltage	n/a	0.78 V	0.41 V
Silicon Resistivity (.005 to .02 $\Omega\text{-cm}$ nominal)	n/a	0.046	0.053

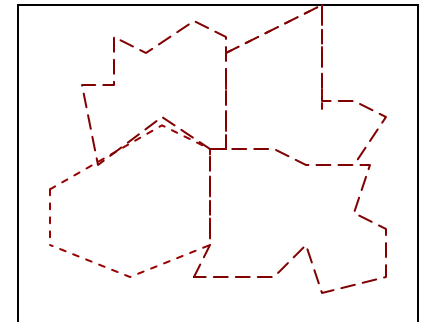
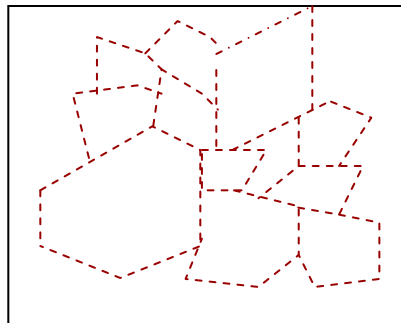
Table 2: Measured and Calculated Data on the Silicon/Aluminum contact interface, and calculated silicon resistivity. Data in parenthesis is from ohm-meter

Sintering: for grain growth

450 C, 15-30 minutes



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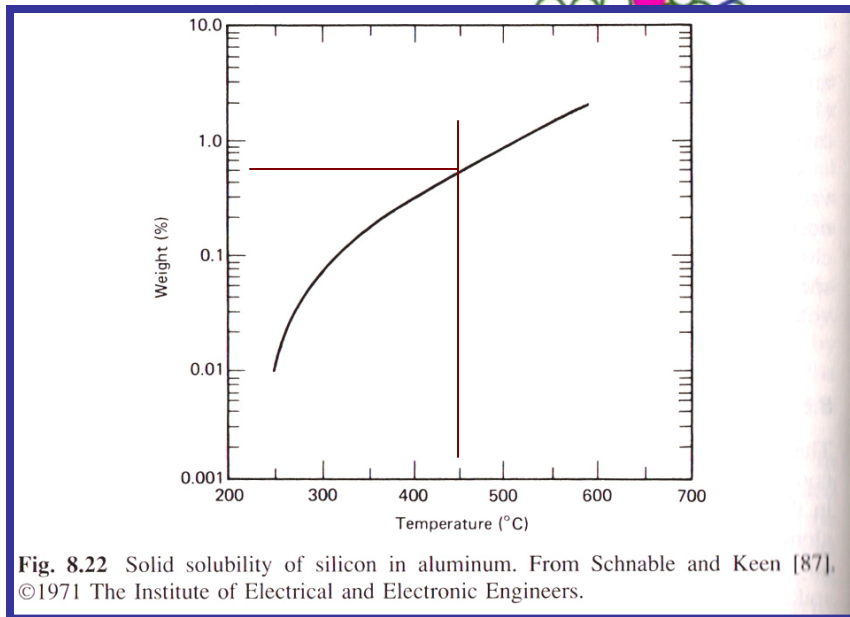
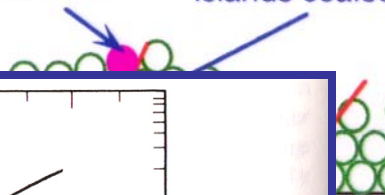


Sintering: what happens at the interface?

450 C, 15-30 minutes

incorporation of impurities

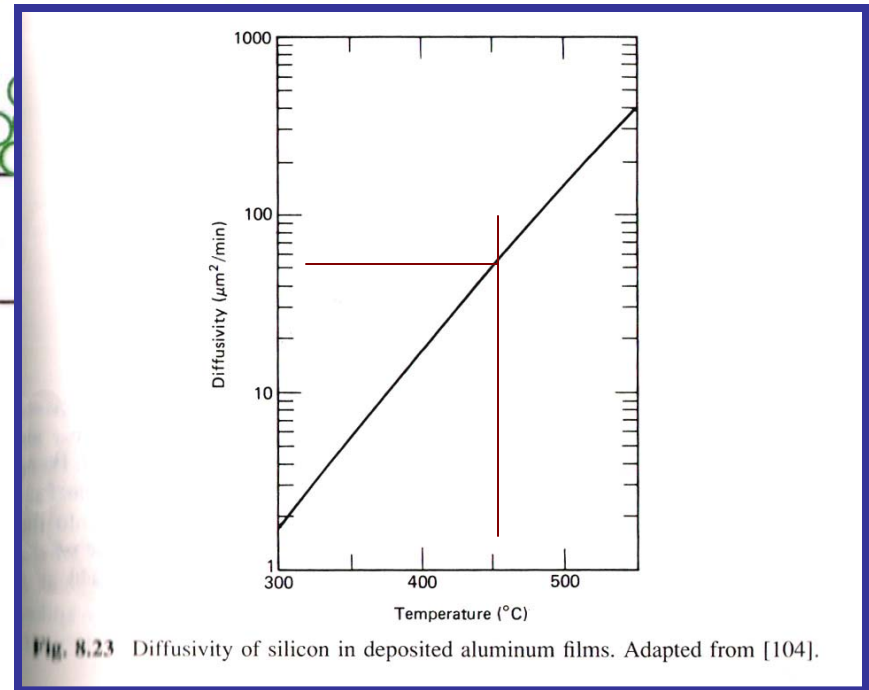
islands coalesce and meet at 'grain boundaries'



Solid Solubility of Si in Al

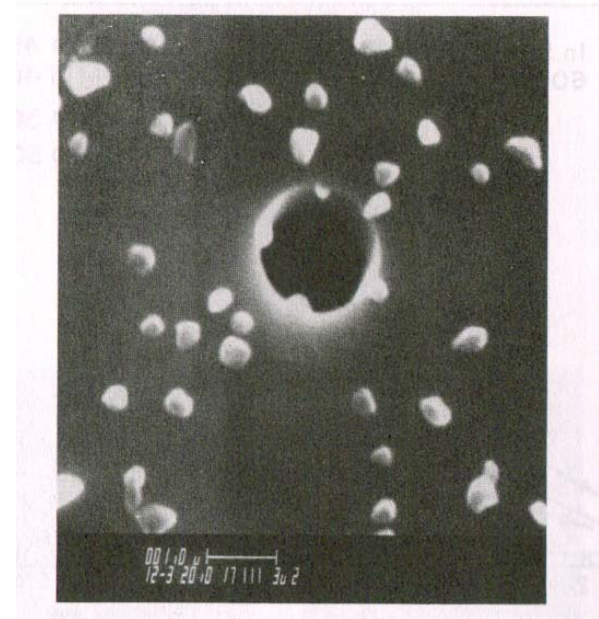
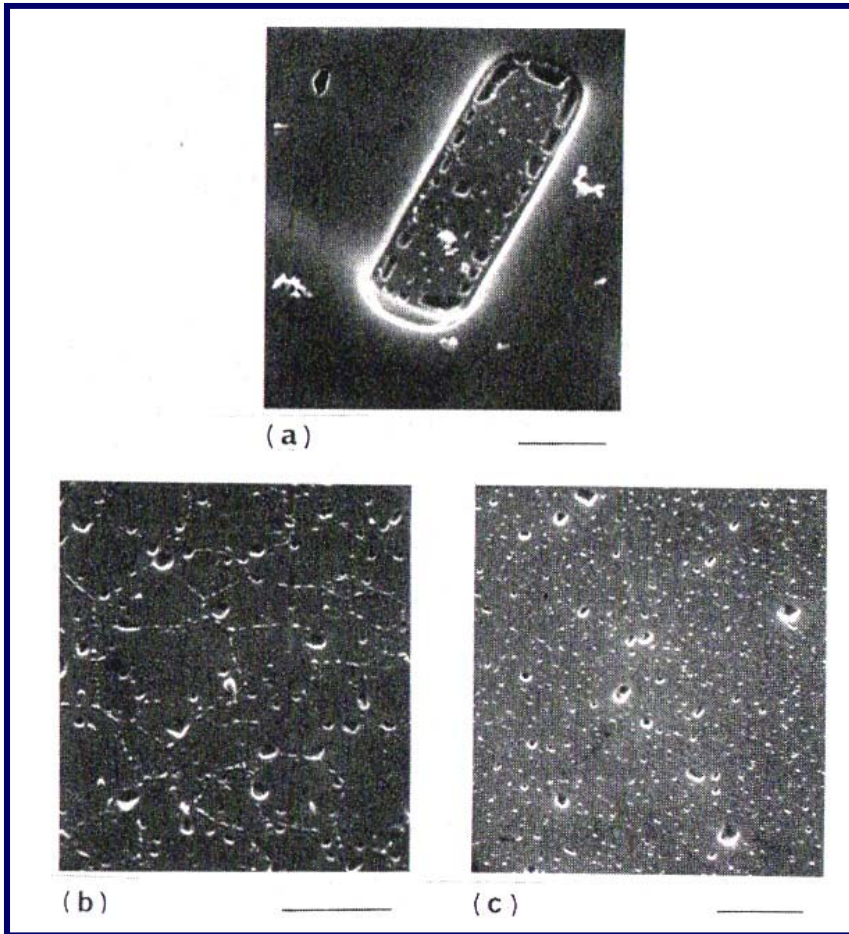
Solid solubility of Al in Si:
0.0011 wt % at 600C

The consequences of these interactions?



Diffusivity of Si in Al films

A method to prevent excessive diffusion of Si into Al?



450 C, 30 min. in H₂

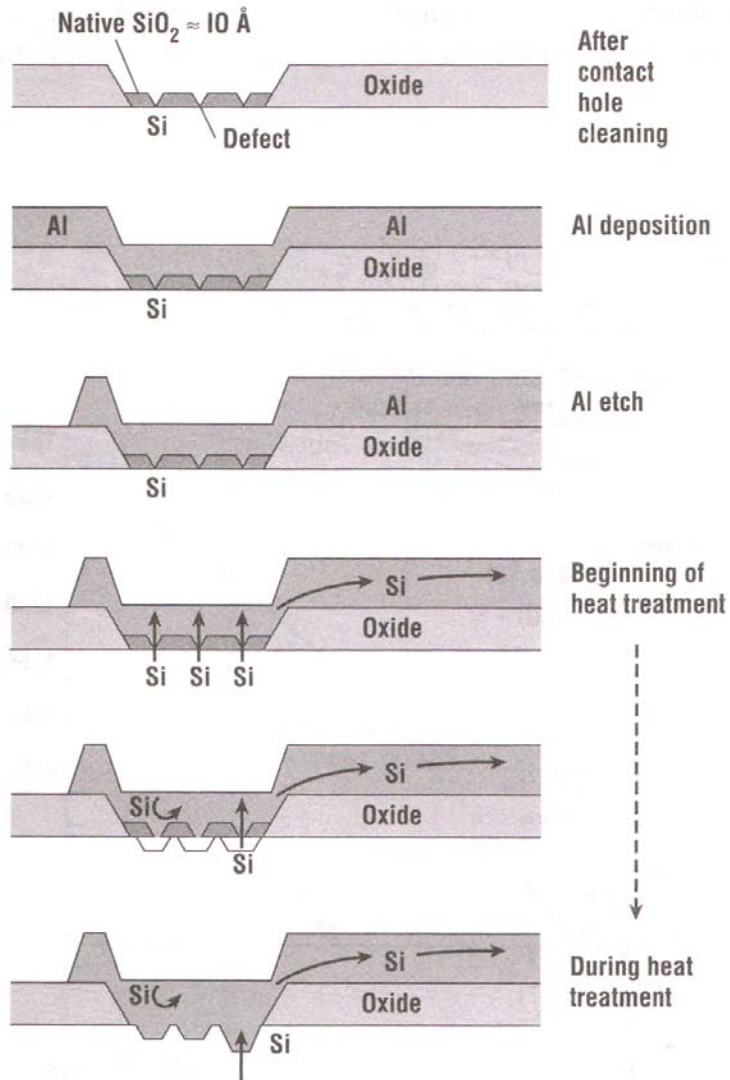


Figure 15.26 Cross-sectional diagrams of Al on Si contact formation process (after Wolf, reprinted by permission, Lattice Press).

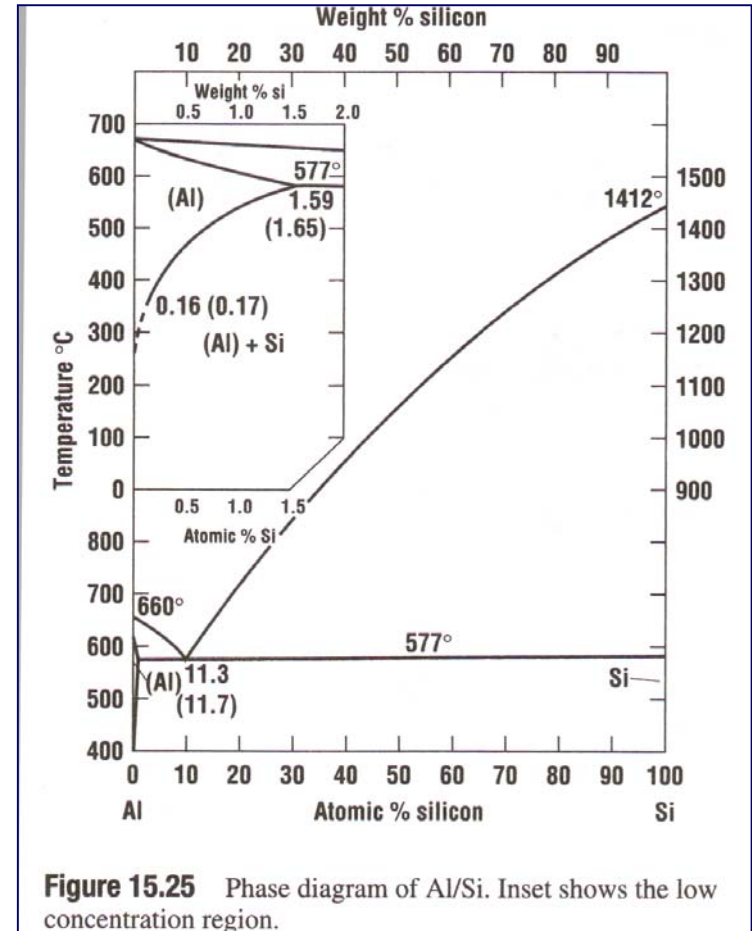


Figure 15.25 Phase diagram of Al/Si. Inset shows the low concentration region.