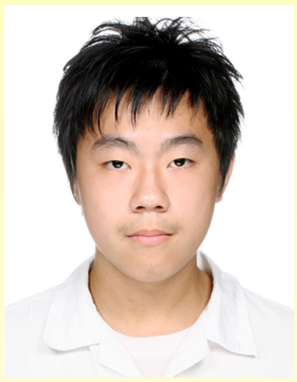
101年大學部國際交流甄選專題成果展



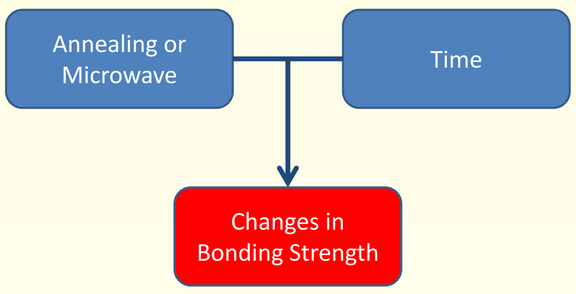
Microwave's Influence on Bonding Strength between Silicon and Silicon Oxide Wafers

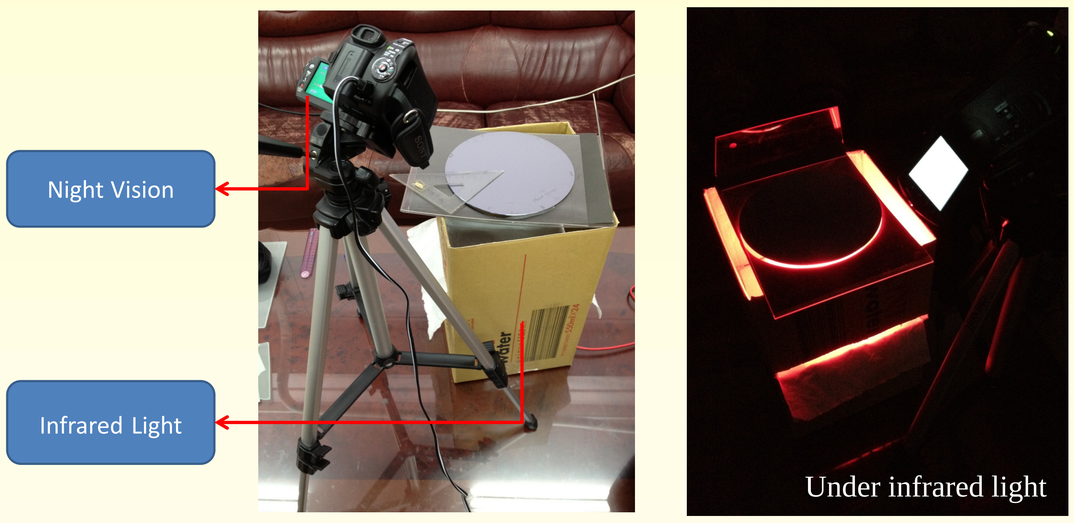
7

Researchers: Justin Wu
Advisor: Prof. Ben Lee

Motives

- To achieve better bonding strength
- Reduction of heating time
- To create uniform heating and enhance material structure
- Simplification of production





Procedures

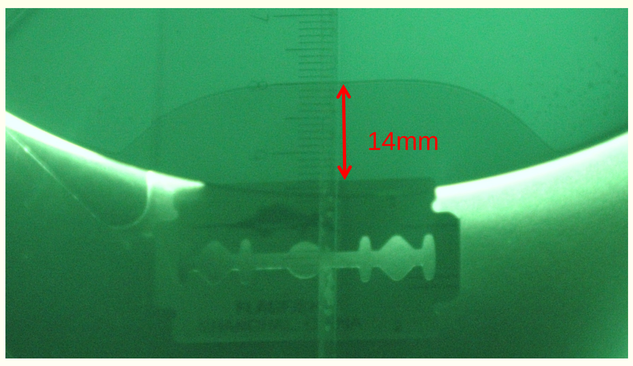
- Excite silicon wafers by H-ion implantation
- Bond two silicon wafers together
- Anneal silicon wafers under 180℃ for 20 or 30 minutes
- Test the bonding strength of silicon wafers by SmartCut procedure, record the testing
- Microwave silicon wafers for 20 minutes by a 900W microwave. (single-time or step-by-step)
- Test the bonding strength of silicon wafers by SmartCut procedure, record the testing

Bonding Strength:

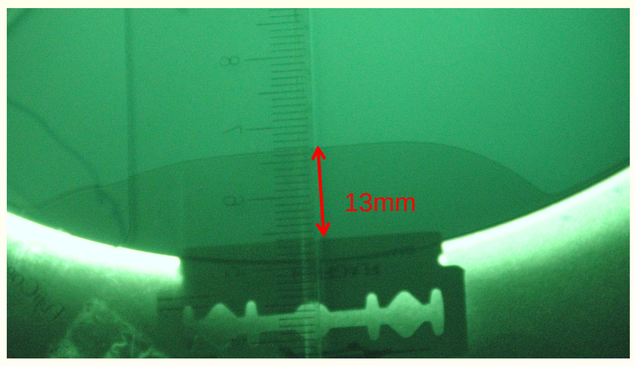
$$\gamma = \frac{32Etw^3{t_b}^2}{32L^4}\left(\frac{J}{m}\right)$$

$$E = 1.3 \times 1011\ (Pa)$$
$$t_w = 630\ (\mu m)$$
$$t_b = 0.1\ (mm)$$

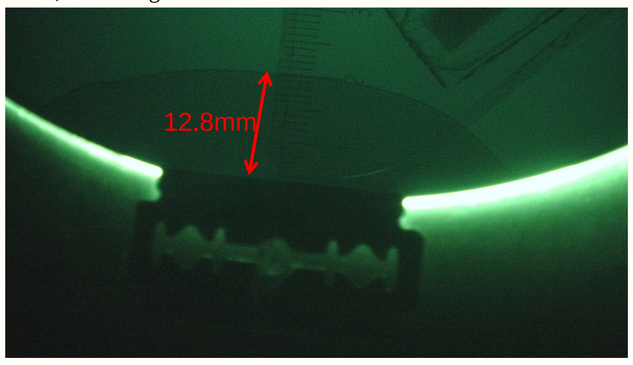
Results



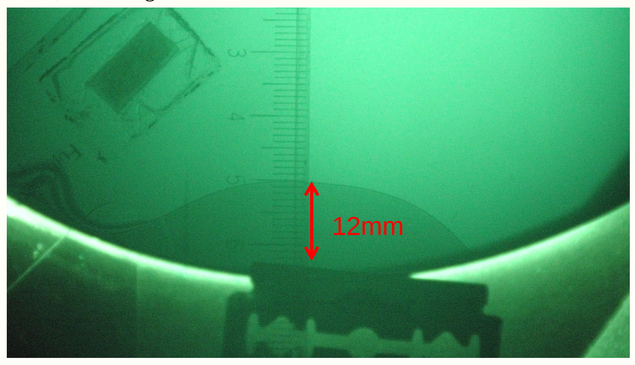
Si/Si; Annealing under 180℃ for 30min.



Si/Si; Annealing under 180℃ 30min. then microwave under 200℃ for 20min.

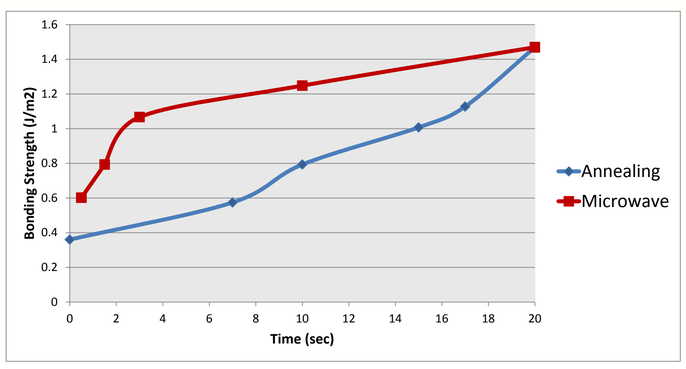


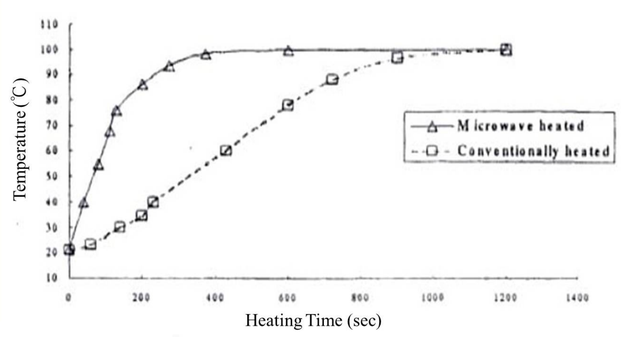
Si/Ox; Annealing under 180℃ 20min. then microwave by 900W for 20min. (single-step)



Si/Ox; Annealing under 180℃ 20min. then microwave by 900W for 20min. (step-by-step)

Test Samples	Annealing Time (min.)	Microwave Time (min.)	Length (mm)	Bonding Strength (J/m2)
Si/Si	-	-	16.3125	0.360156309
Si/Si	30	-	14	0.866332003
Si/Si	-	20	15.5	0.574275477
Si/Ox	-	-	14	0.79327567
Si/Ox	20	-	13.2	1.007193598
Si/Ox	20	20	12.8333333	1.127409
Si/Ox	20	20 (step-by-step)	12	1.469641113





References

- Chin Han, Gin "Microwave Chemistry"

In the 1950s, Raytheon Company found that the microwave heating effect can be seen as a source of energy, used in consumer, industrial, and scientific research.

- David E. Clark and Willard H. Sutton, "Microwave Processing of Materials", Annu. Rev. Mater. Sci

By integrating radiative heating and microwave heating, the temperature gradient is more uniformed, because microwave heating is for overall, and the external heat source can reduce the surface heat loss to a minimum.

Future Objectives