

Correlation between Hot Plate Emissivity and Wafer Temperature at Low Temperatures

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A five wafer batch annealing system using resistively heated, stacked hot aluminum plates has been designed and released for low temperature (100 – 450°C) annealing applications for 150mm, 200mm, and 300mm wafers. [1] Each wafer is placed between two temperature-controlled hot plates and the wafer is gradually heated by thermal conduction, convection and radiation through ambient gas (Fig.1). In this study effect of aging the aluminum hot plates in air ambient on emissivity of the hot plates and correlation between the emissivity and wafer temperature under various hot plate temperatures were investigated to understand—radiation effect during low temperature annealing.

Aging (oxidation) of newly machined aluminum hot plates at 550°C in 1atm air ambient increased emissivity of the hot plates gradually until its saturation point of ~0.18 at approximately 25 hours (Fig.2). The slower increase of emissivity was observed in lower temperature aging. Strong correlation between Si wafer temperature measured by K-type thermocouples and emissivity of surrounding hot plates was observed. A higher saturated wafer temperature was achieved with higher hot plate emissivity at a given hot plate temperature (Fig. 3). We experimented with various types of wafers such as Si, GaAs and quartz wafers to investigate the effect of optical properties of wafers in low temperature annealing under various infrared radiation environment.

Even at the same hot plate temperature and ambient, a variation of surrounding hot plate emissivity can results in a wafer temperature variation. To make a highly repeatable low temperature annealing successful, optical property of wafers must be monitored and the emissivity of surrounding hot plates must be controlled.

REFERENCES

1. W.S.Yoo, T. Fukada and J.Yamamoto; *European Semiconductor April 2001*.

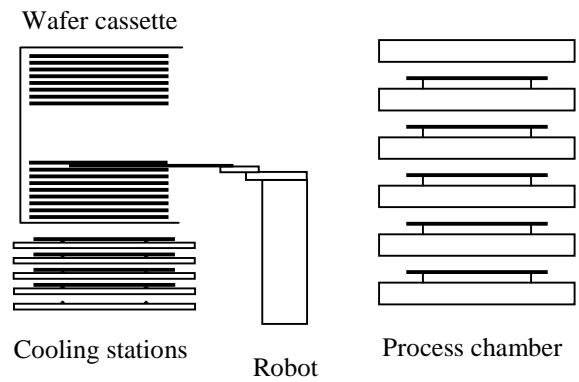


Fig. 1 Schematic diagram of a five wafer batch annealing system.

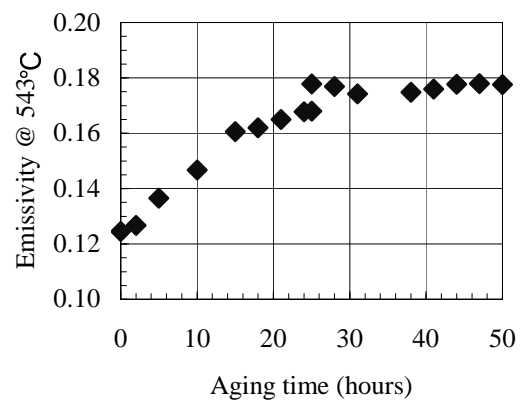


Fig. 2 Aluminum heater emissivity as a function of aging time. (Aging condition; 550°C, 1atm air)

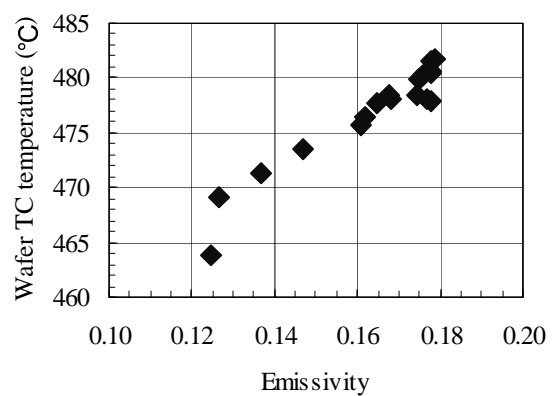


Fig.3 Correlation between wafer temperature and hot plate emissivity at a hot plate temperature of 550°C.