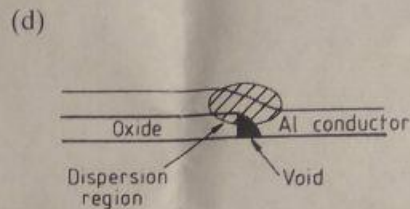
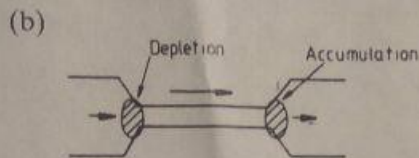
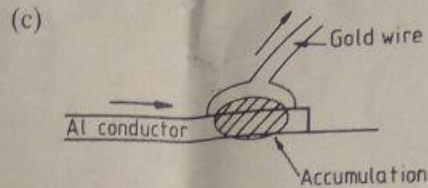


ELEC-E8712 Design for Reliability (5 cr)

3rd midterm exam 13.12.2018

1. Answer following Integrated Circuit (IC) thin film related questions.
- a) What kind of corrosion mechanisms are observed in IC level Al connectors (1p)
 - b) Explain shortly the mechanism and driving forces for stress migration and electromigration. (2p)
 - c) With the help of the figures below, **explain** the critical locations for electromigration failures. (2p)

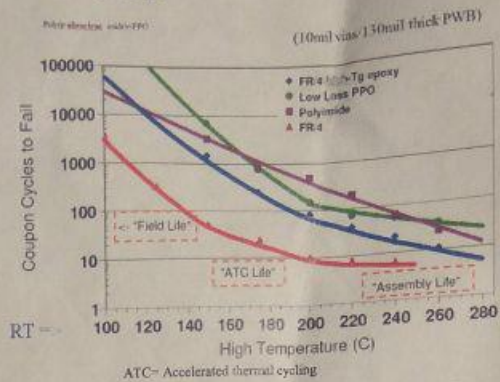
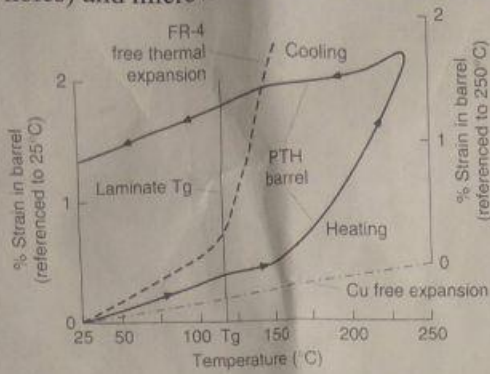


- c) What are the most common methods (/materials) used in die attach? (2p)
- d) Explain shortly the high-temperature reliability challenge with Au-Al interface (Au ball bond with Al pad) under high temperature usage (see figure below). (2p)



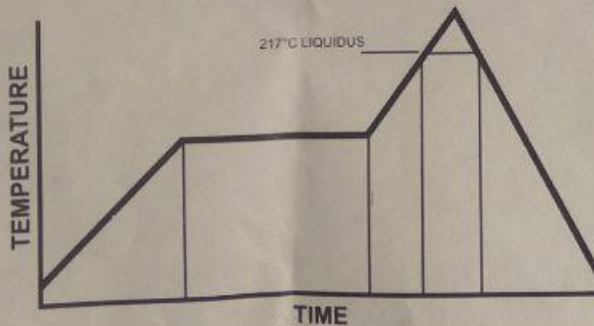
- e) What are the main advantages and disadvantages of Flip-Chip technology compared to wire bonding technology? (2p)

2. With the help of the table and figures below, please explain how (and why) the changes in temperature have significant effect on the reliability of the PTH (Plated through holes) and microvias of PCBs (Printed Circuit Boards). (4p)



Environmental Property	Material					
	FR-4 (Epoxy E-glass)	Multi-Functional Epoxy	High Performance Epoxy	Bismaleimide Triazine/ Epoxy	Polyimide	Cyanate Ester
Coefficient of Thermal Expansion, xy-plane, CTE(xy) (ppm/°C)	16 - 19	14 - 18	14 - 18	-15	8 - 18	-15
Coefficient of Thermal Expansion, z-axis below T_g , CTE(z, < T_g) (ppm/°C)	50 - 85	44 - 80	~44	-70	35 - 70	-81
Coefficient of Thermal Expansion z-axis above T_g , CTE(z, > T_g) (ppm/°C)	240 - 390	240 - 390	240 - 390	TBD	TBD	TBD

3. Explain the basic stages in s.c "reflow profile" and define shortly their effects on solder joint (SnAgCu=SAC solder, $T_{mp}=217^\circ\text{C}$) quality and reliability [NB. Pay specific attention to time and temperature above liquidus ($T > 217^\circ\text{C}$) and the formation of solder interconnection microstructure]. (6p)



Essay type answers are NOT required!