

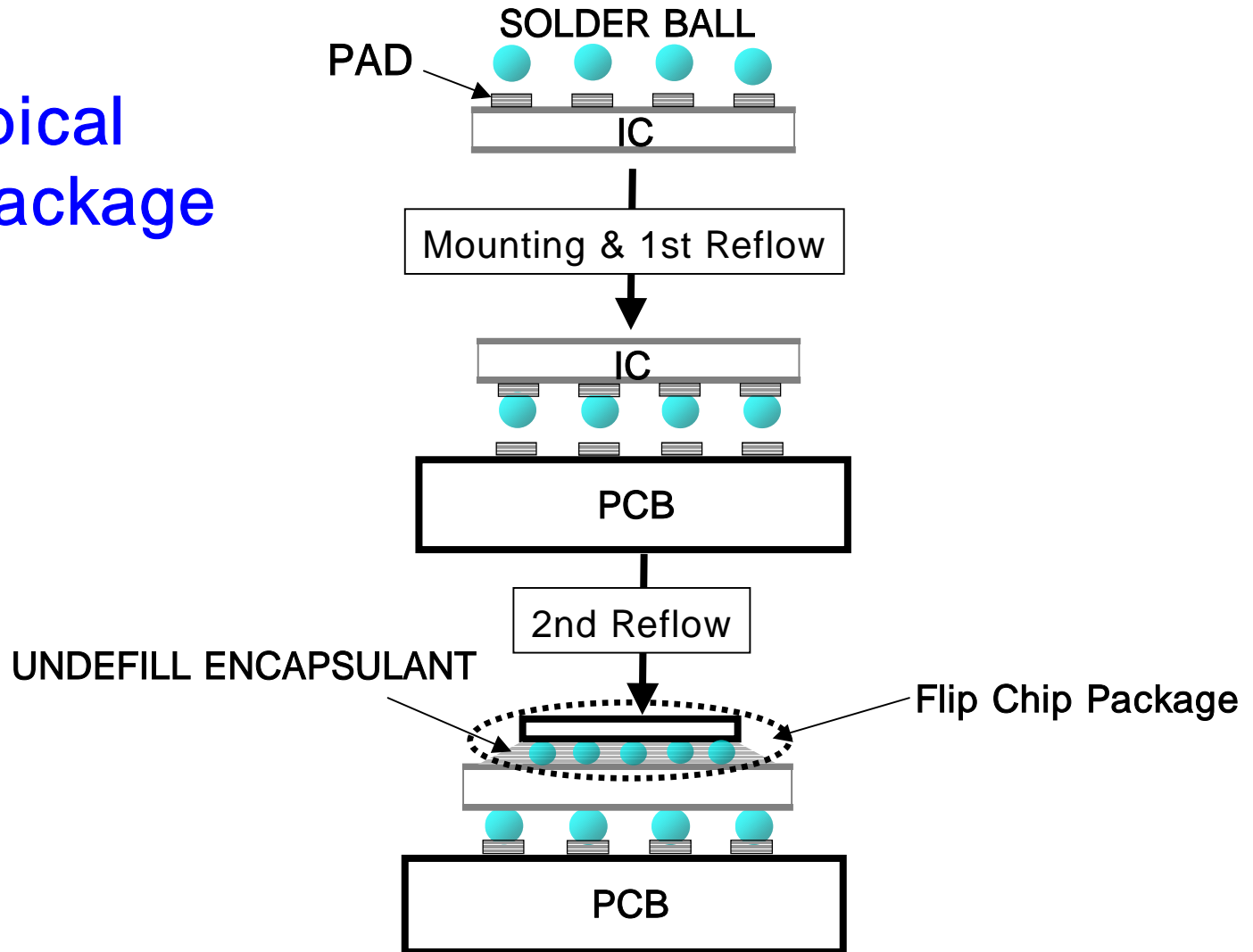


# Wetting balance

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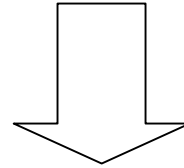


## A typical BGA package





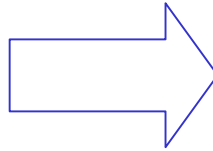
- ◆ Fine pitch package
- ◆ Pb-free solder
- ◆ Fluxless soldering



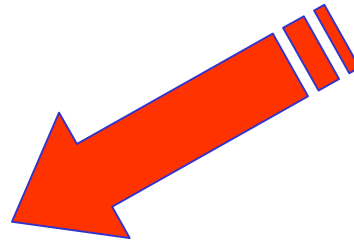
***Wettability & Reliability***



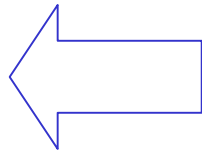
*Wettability*



**Surface tension**  
**Contact angle**



**Reliability**  
**Life prediction**



**Intermetallic compound**  
**Physical properties**

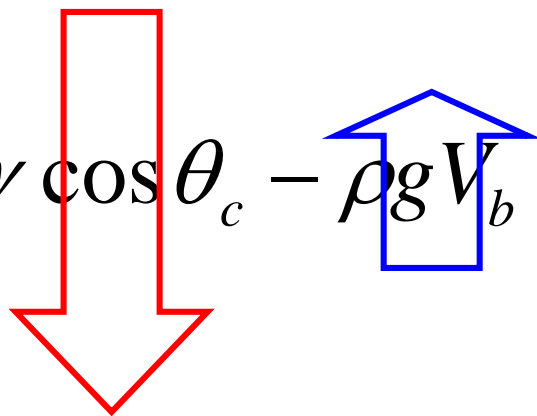


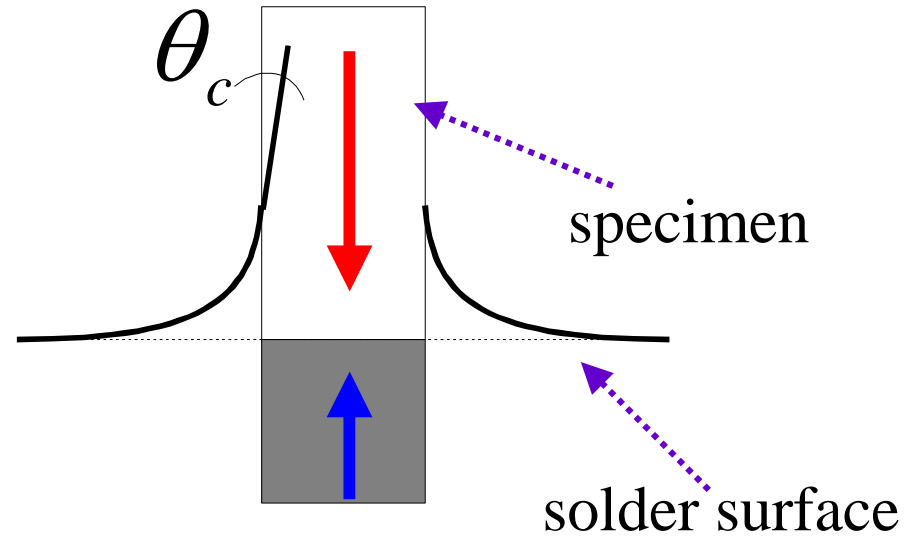
- ◆ Area of spread method
- ◆ Dip & look method
- ◆ *Wetting Balance Method*

Quantitative Analysis  
Reproducibility  
Time dependent wetting behavior



## Force balance equation

$$F = p\gamma \cos \theta_c - \rho g V_b$$




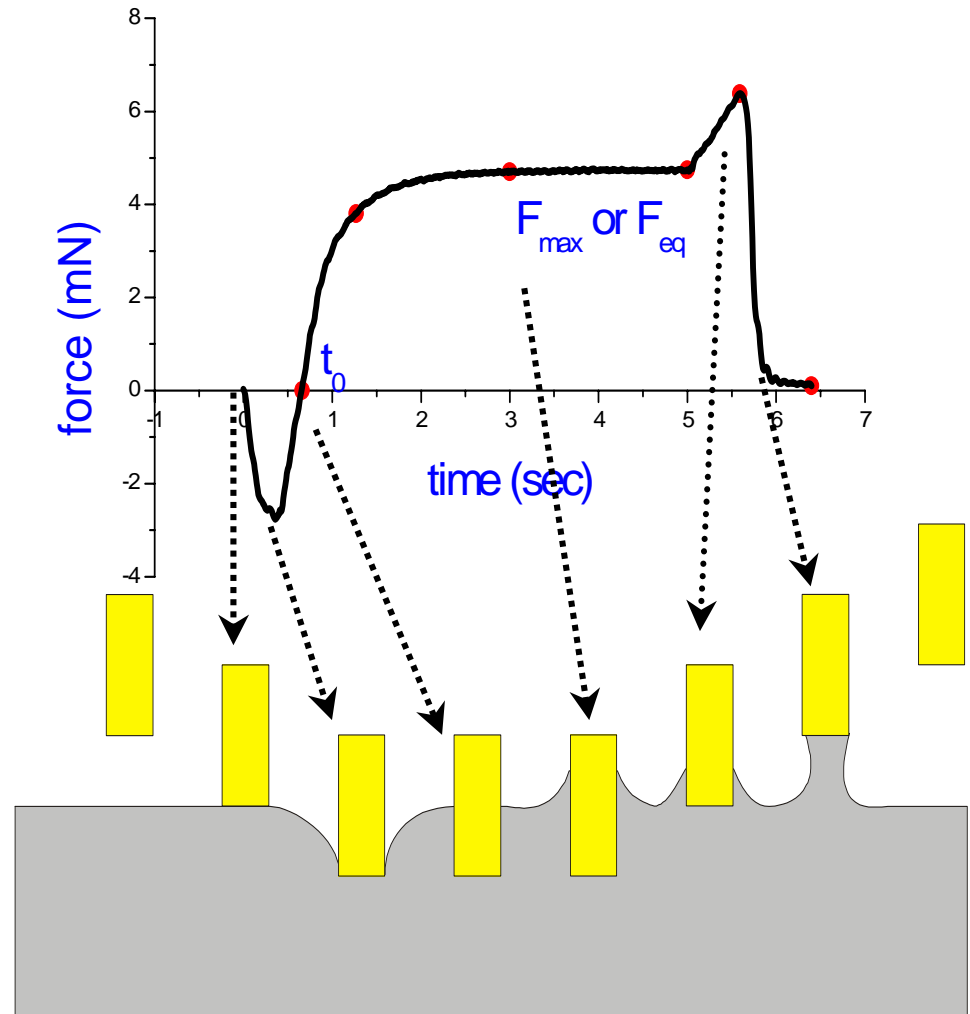
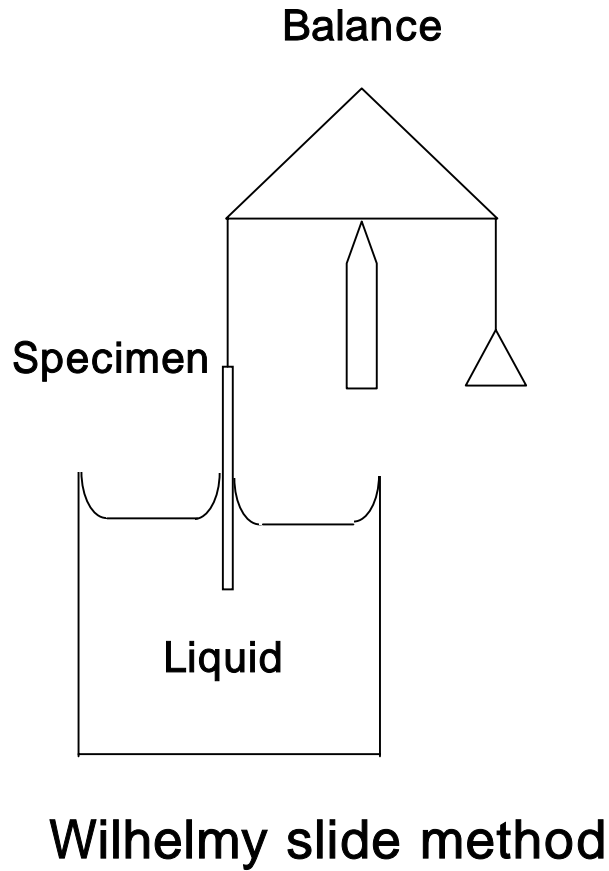
$\gamma$  = surface tension of solder in contact with flux,

$p$  = periphery of specimen,  $\theta_c$  = contact angle

$V_b$  = volume immersed

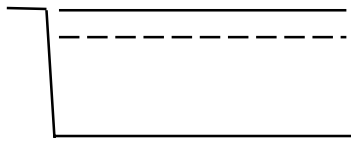


# Wetting Balance Curve

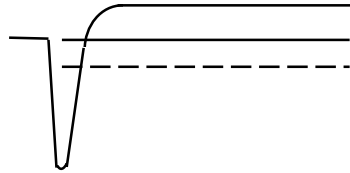




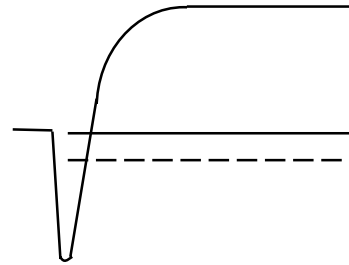
# The problem of wettability



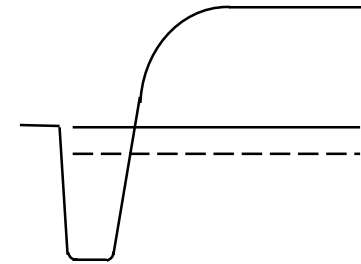
Non - wetting



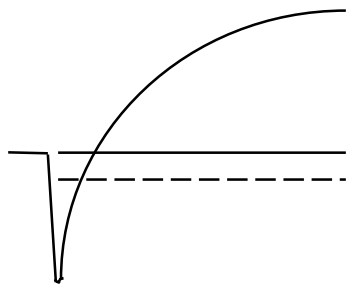
Poor wetting



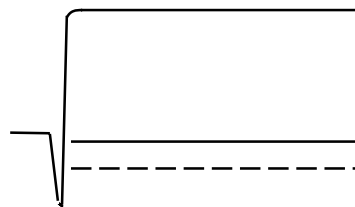
Good wetting



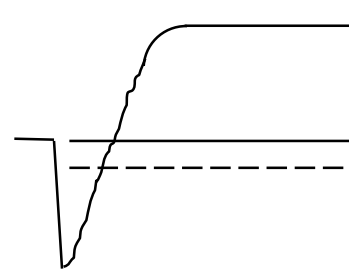
Retarded wetting



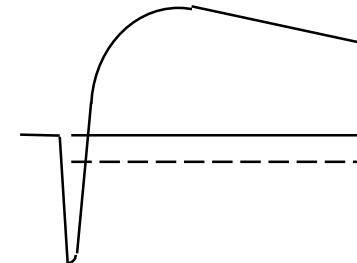
Slow wetting



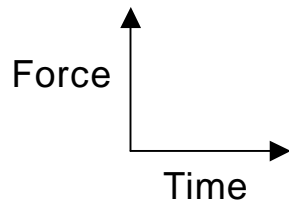
Very fast wetting



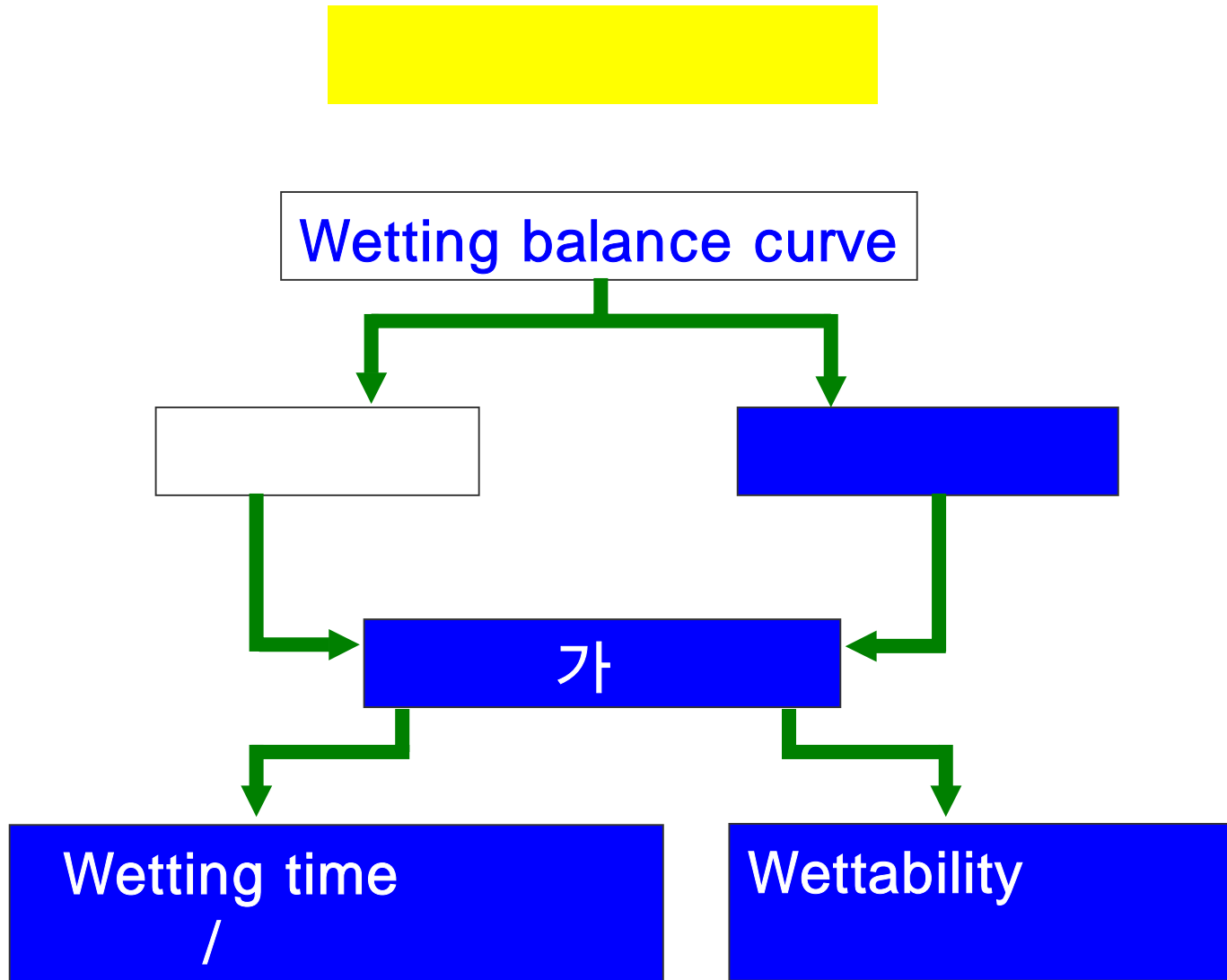
Wetting limited by  
Thermal demand



Unstable wetting  
(DE - WETTING)









## – Commercial package “Flow3D”

### *Governing Equation*

*Continuity Equation*

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho V) = 0$$

*Momentum Equation*

$$\rho \frac{\partial V}{\partial t} = \rho g - \nabla p + \nabla \cdot \tau_{ij}$$

*Viscous-dissipation function*

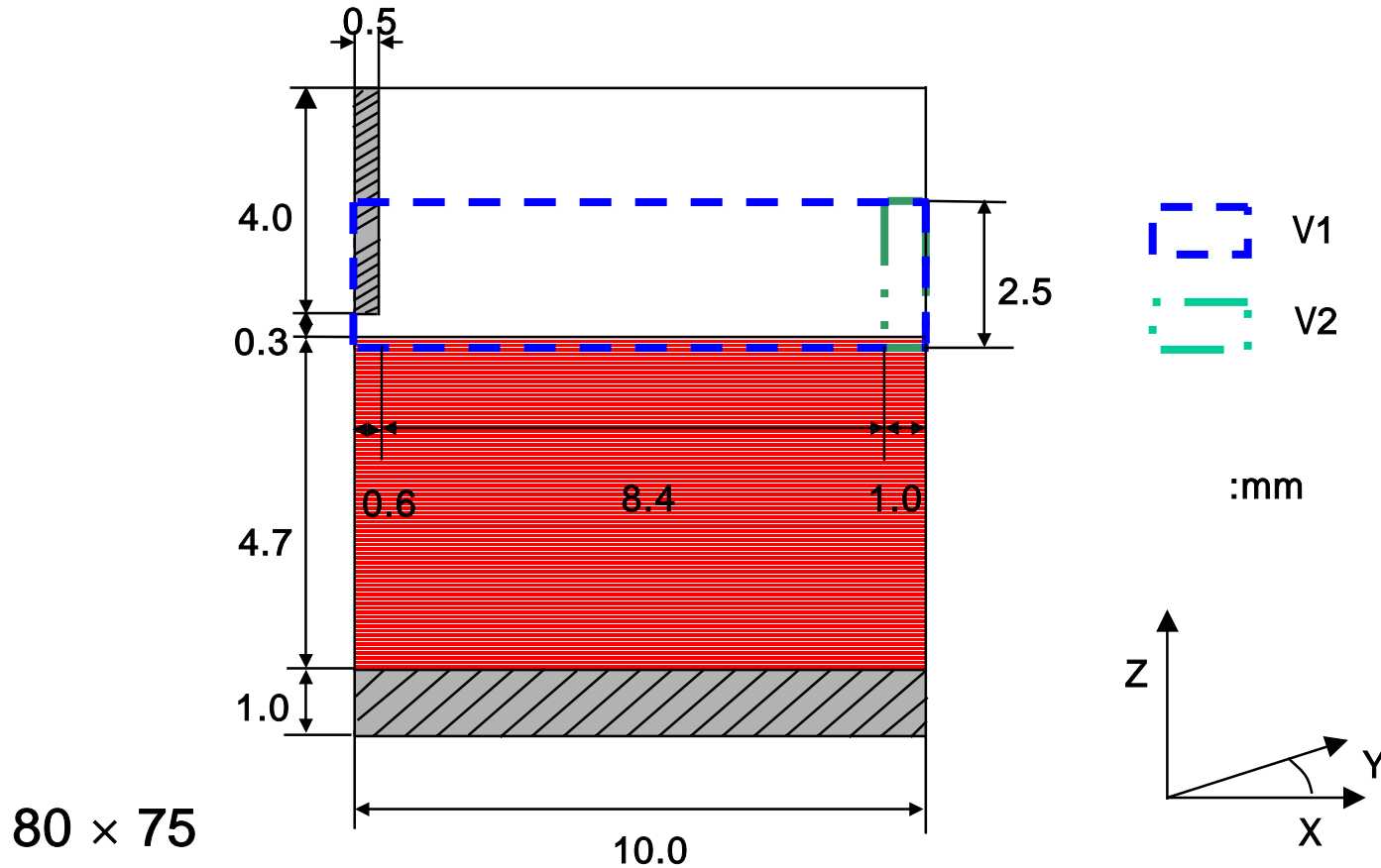
$$\Phi = \mu \left[ 2 \left( \frac{\partial u}{\partial x} \right)^2 + 2 \left( \frac{\partial v}{\partial y} \right)^2 + 2 \left( \frac{\partial w}{\partial z} \right)^2 + \left( \frac{\partial w}{\partial y} + \frac{\partial v}{\partial z} \right)^2 + \left( \frac{\partial u}{\partial z} + \frac{\partial w}{\partial x} \right)^2 \right]$$



	(63Sn - 37Pb)		8.4 g/cm <sub>3</sub>
			0.49 N/m
	(Cu)		8.93 g/cm <sub>3</sub>
(2 )		0.0 - 1.3	
		1.3 - 2.0	
		1mm	
		1mm/s	
		1mm	
Solder		230°C	

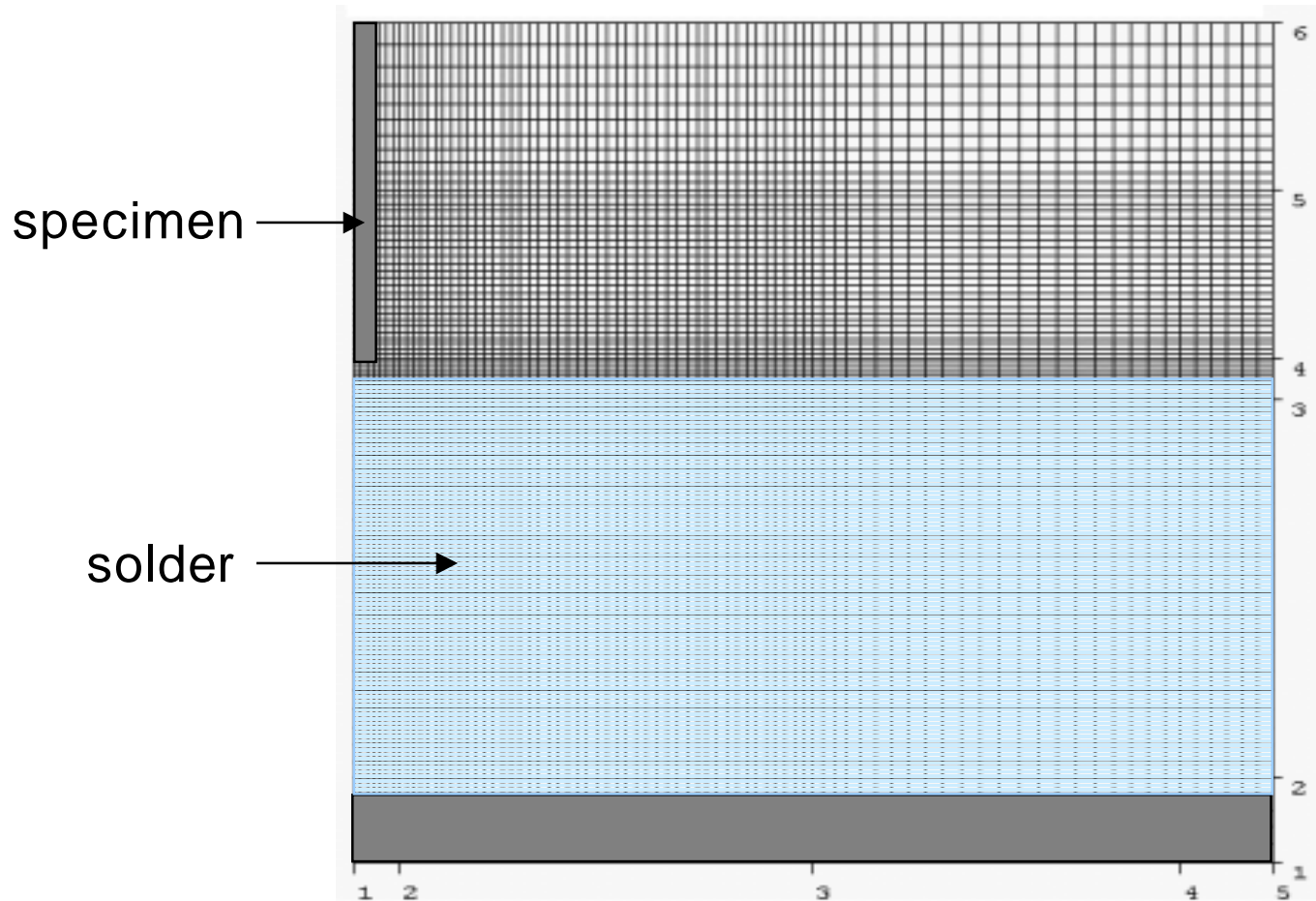


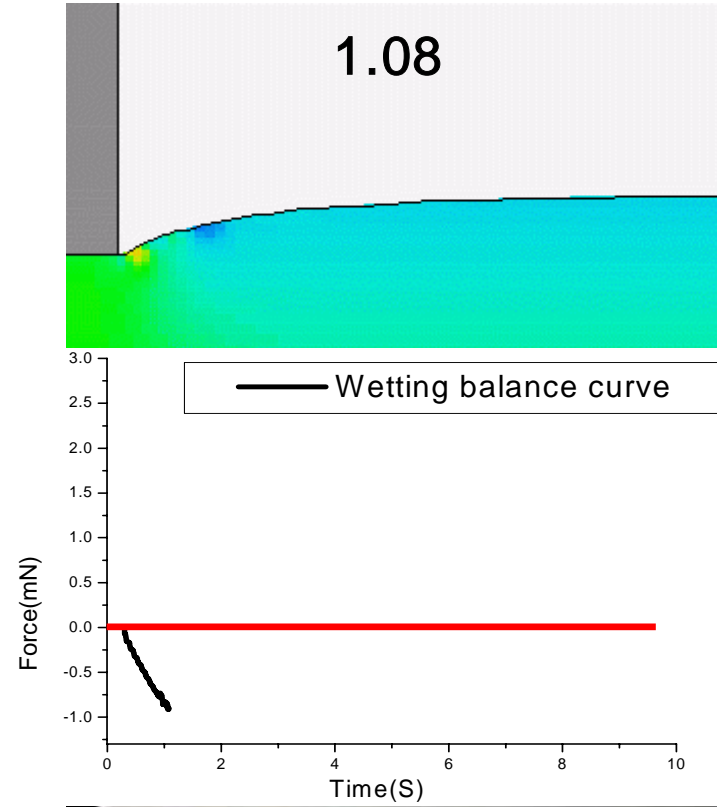
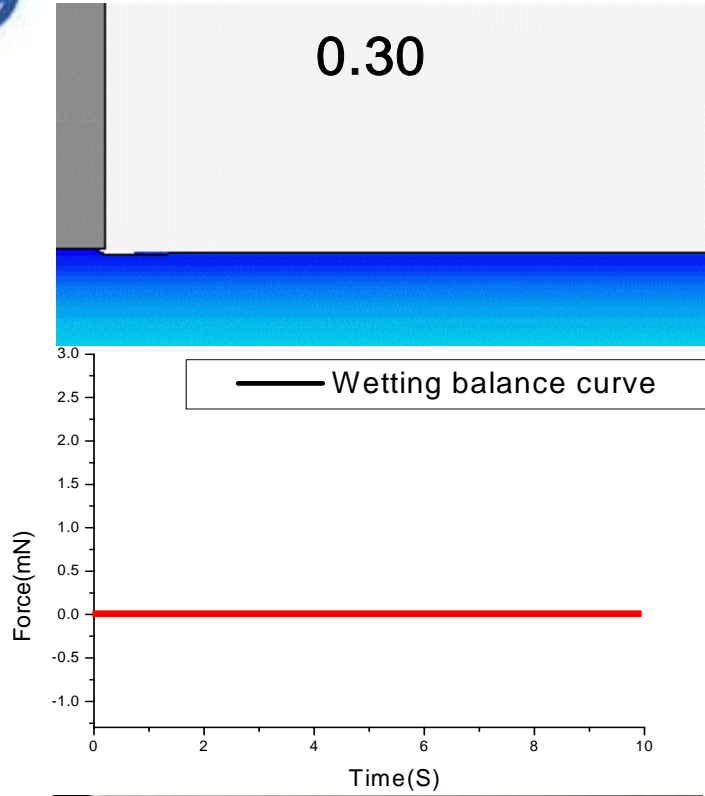
# Cylindrical Coordinate System

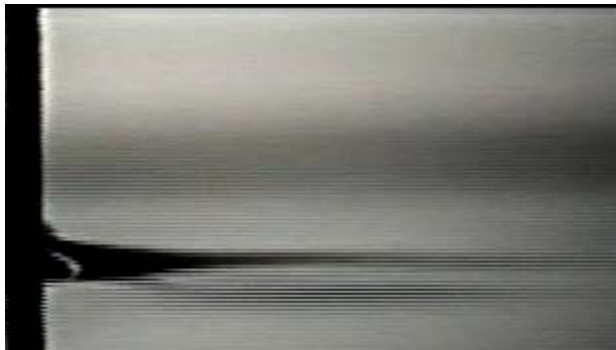
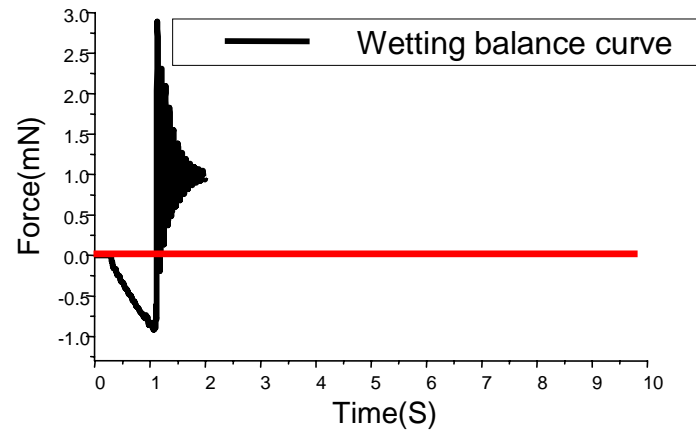
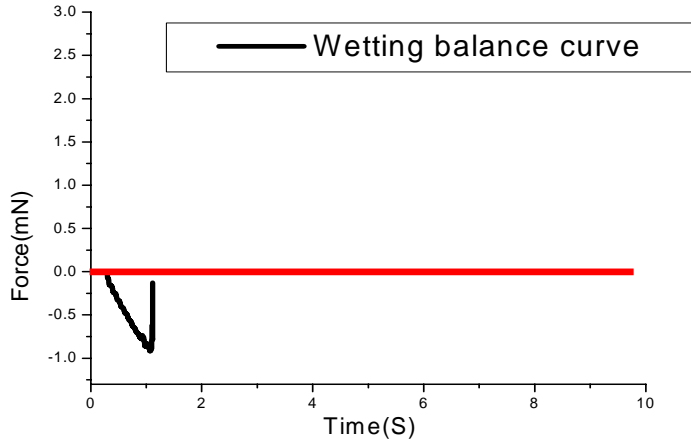
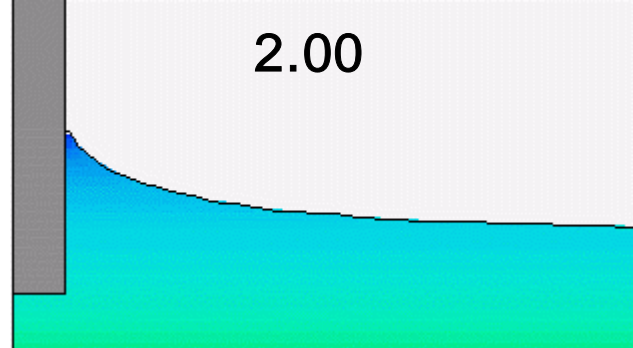
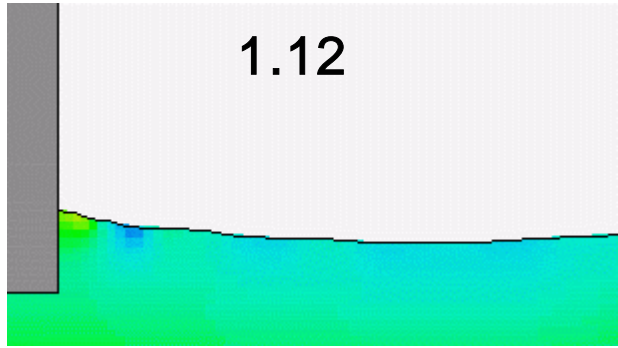


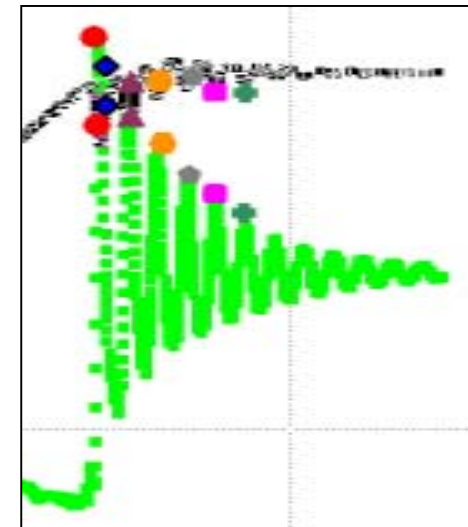
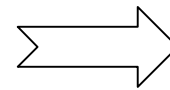
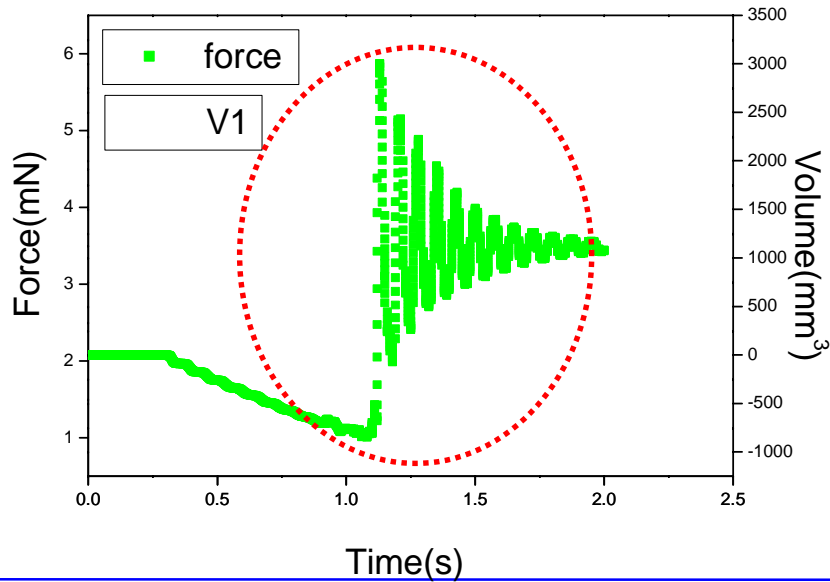
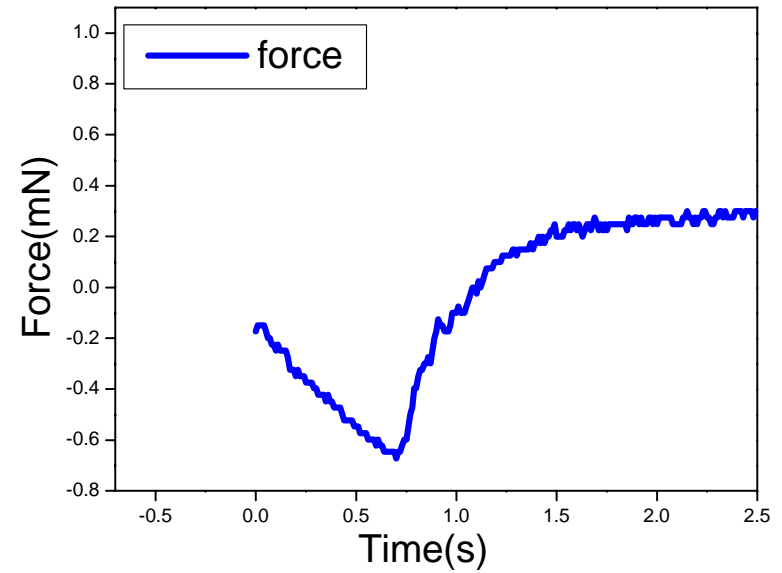


# Mesh generation













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Wetting balance curve

