1.) Determine the chip speed that is associated with the first layer of wiring structure given in the figure below assuming that the metal is either Aluminum or Copper. The wire has a line thickness of 0.25 μm, height of 0.75 μm and average length of 10 mm and the dielectric material that was between the wiring but removed for this image is SiO2 and has a wire-to-wire gap of 0.75 μm. How much faster is the Copper based chip than the Aluminum based chip?

DATA:	Electrical Resistivity	Refractive Index	Permitivity
Aluminum	2.824 *cm		
Copper	1.724 *cm		
SiO2		1.55	
Vacuum			8.854x10^-12 farad/m

Metal Wiring

Transistor

SCI

Oxide Insulator

Silicon Wafer
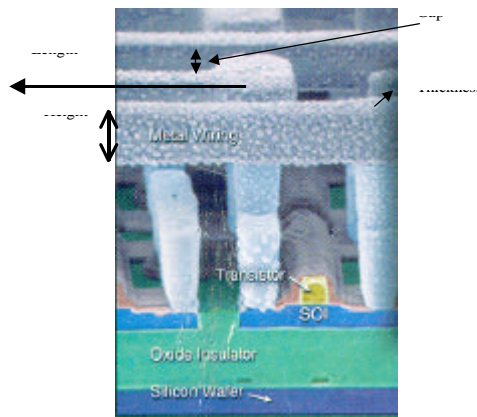
Problem 1 Chip Speed

Data

$\mu m := 10^{-6} \cdot m$

$\rho_{Cu} := 1.724 \cdot 10^{-6} \cdot ohm \cdot cm$

$\rho_{Al} := 2.824 \cdot 10^{-6} \cdot ohm \cdot cm$

$n_{SiO2} := 1.55$

$GHz := 10^{9} \cdot Hz$

$\varepsilon_{o} := 8.854 \cdot 10^{-12} \cdot \dfrac{F}{m}$

$\varepsilon_{SiO2} := n_{SiO2}^{2}$ Dielectric Constant for Optical frequency

$Thickness := 0.25 \cdot \mu m$ $Gap := 3 \cdot Thickness$

$Height := 3 \cdot Thickness$

$Length := 40000 \cdot Thickness$

$Length = 10 \, mm$

$Area_{wire} := Height \cdot Thickness$

$Area_{plate} := Length \cdot Height$

$R_{Al} := \rho_{Al} \cdot \dfrac{Length}{Area_{wire}}$

$R_{Cu} := \rho_{Cu} \cdot \dfrac{Length}{Area_{wire}}$

$C := \varepsilon_{SiO2} \cdot \varepsilon_{o} \cdot \dfrac{Area_{plate}}{Gap}$

$Chip\_Speed := (R_{Al} \cdot C)^{-1}$

$Chip\_Speed = 3.121 \, GHz$ Al wiring

$Chip\_Speed := (R_{Cu} \cdot C)^{-1}$

$Chip\_Speed = 5.113 \, GHz$ Cu wiring