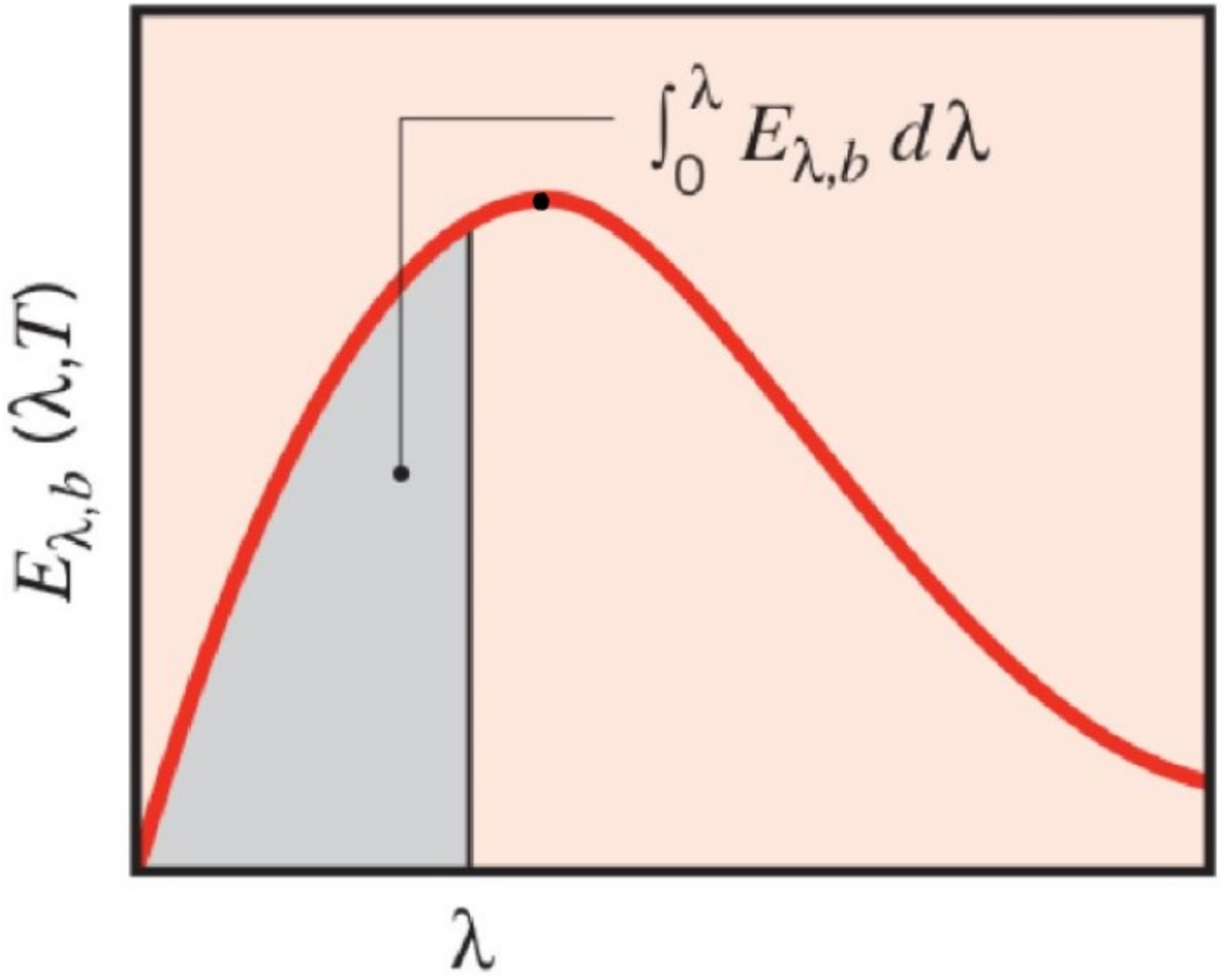
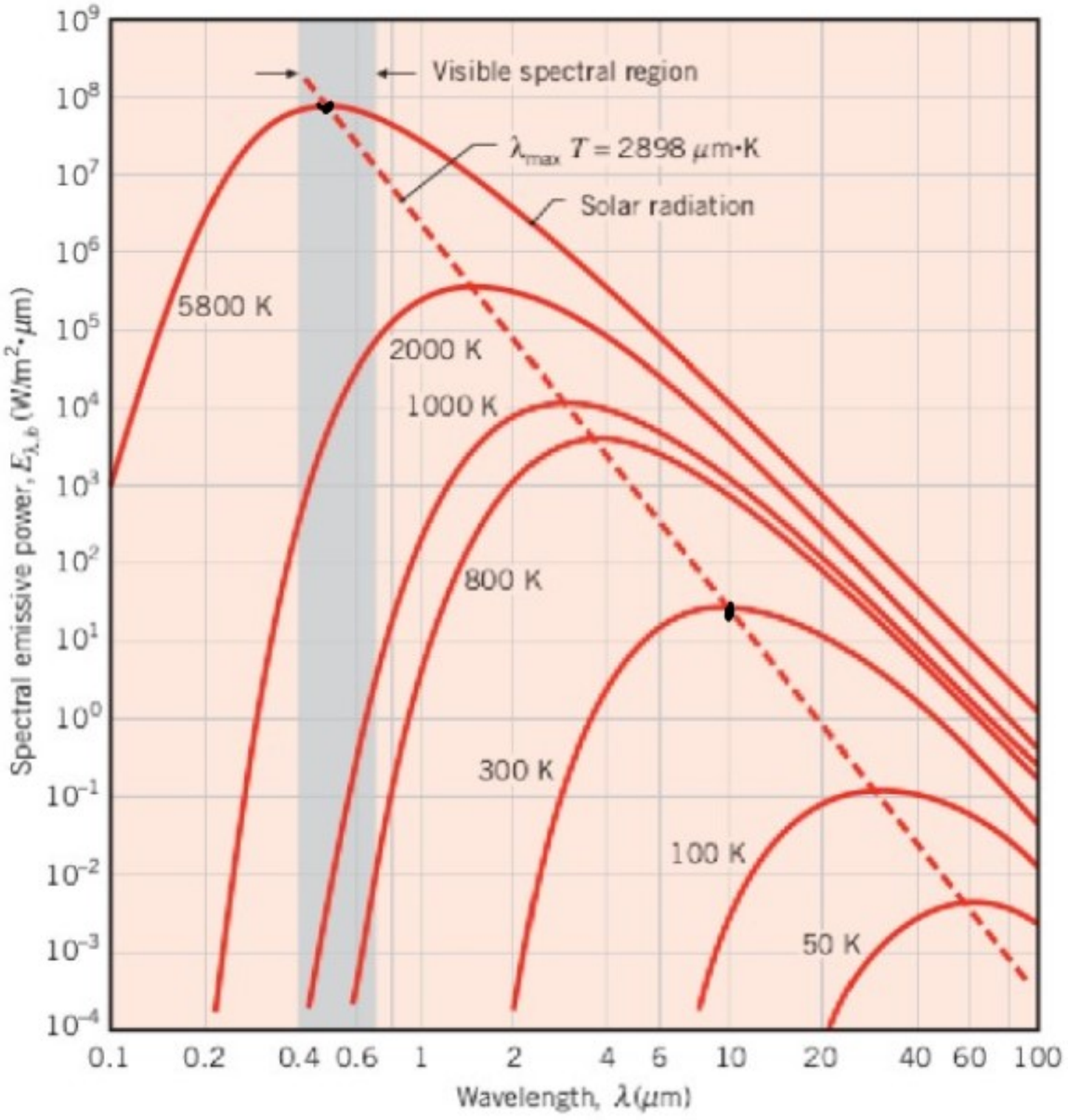
$$E_b = \int_0^\infty E_{\lambda b}(\lambda, T)\, d\lambda = \sigma T^4$$

$$\sigma = 5.670 \times 10^{-8} \ \frac{W}{m^2 K}$$


$\int_0^\lambda E_{\lambda,b}\, d\lambda$
$E_{\lambda,b}\,(\lambda,T)$
λ

$\lambda_{max} T = C_3$ $\qquad$ $C_3 = 2898\ \mu m k$


Visible spectral region
$\lambda_{max}\,T = 2898\ \mu m \cdot K$
Solar radiation
5800 K
2000 K
1000 K
800 K
300 K
100 K
50 K
Spectral emissive power, $E_{\lambda,b}$ (W/m^2·μm)
Wavelength, λ(μm)
10^{9}
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0.1
0.2
0.4
0.6
1
2
4
6
10
20
40
60
100

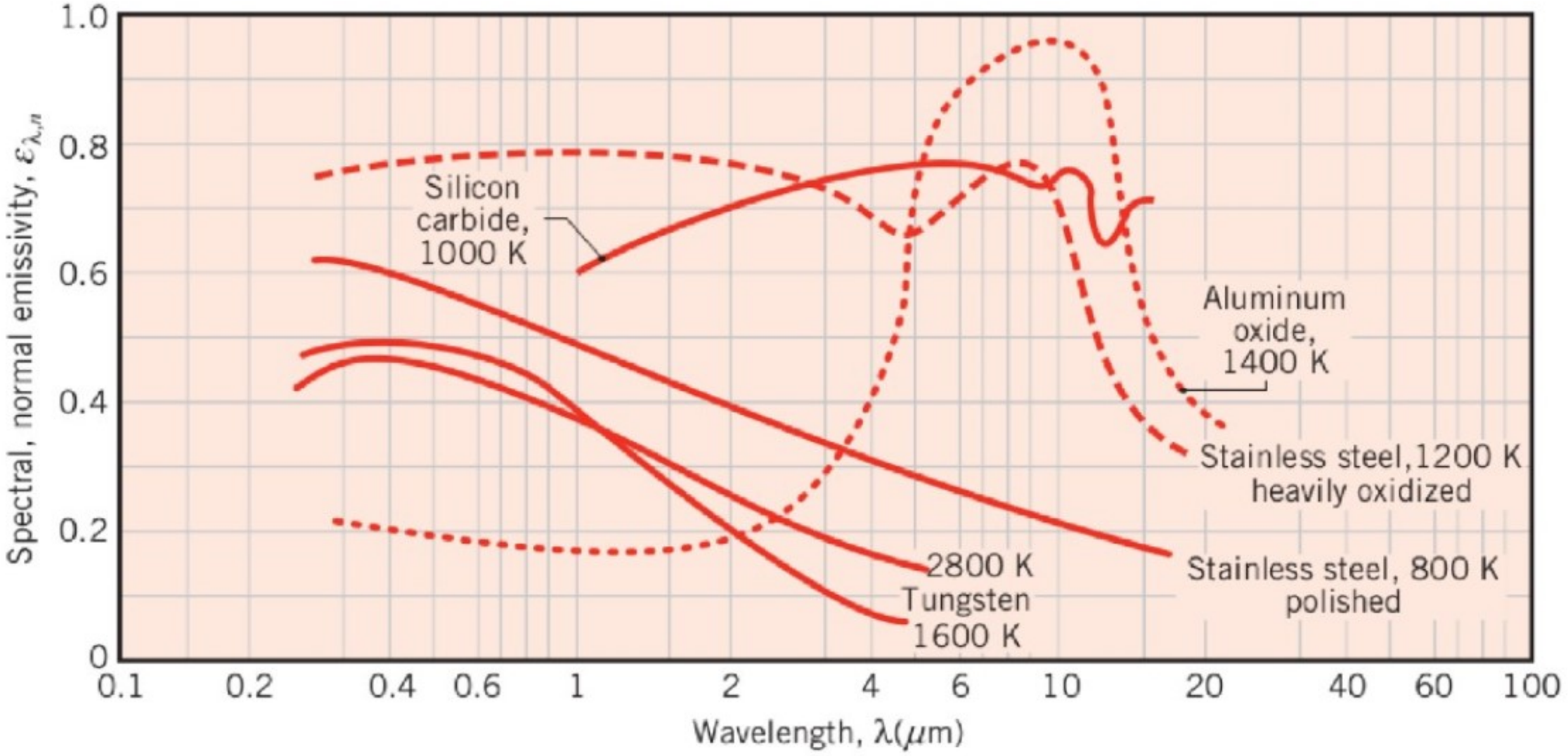
Real Surfaces

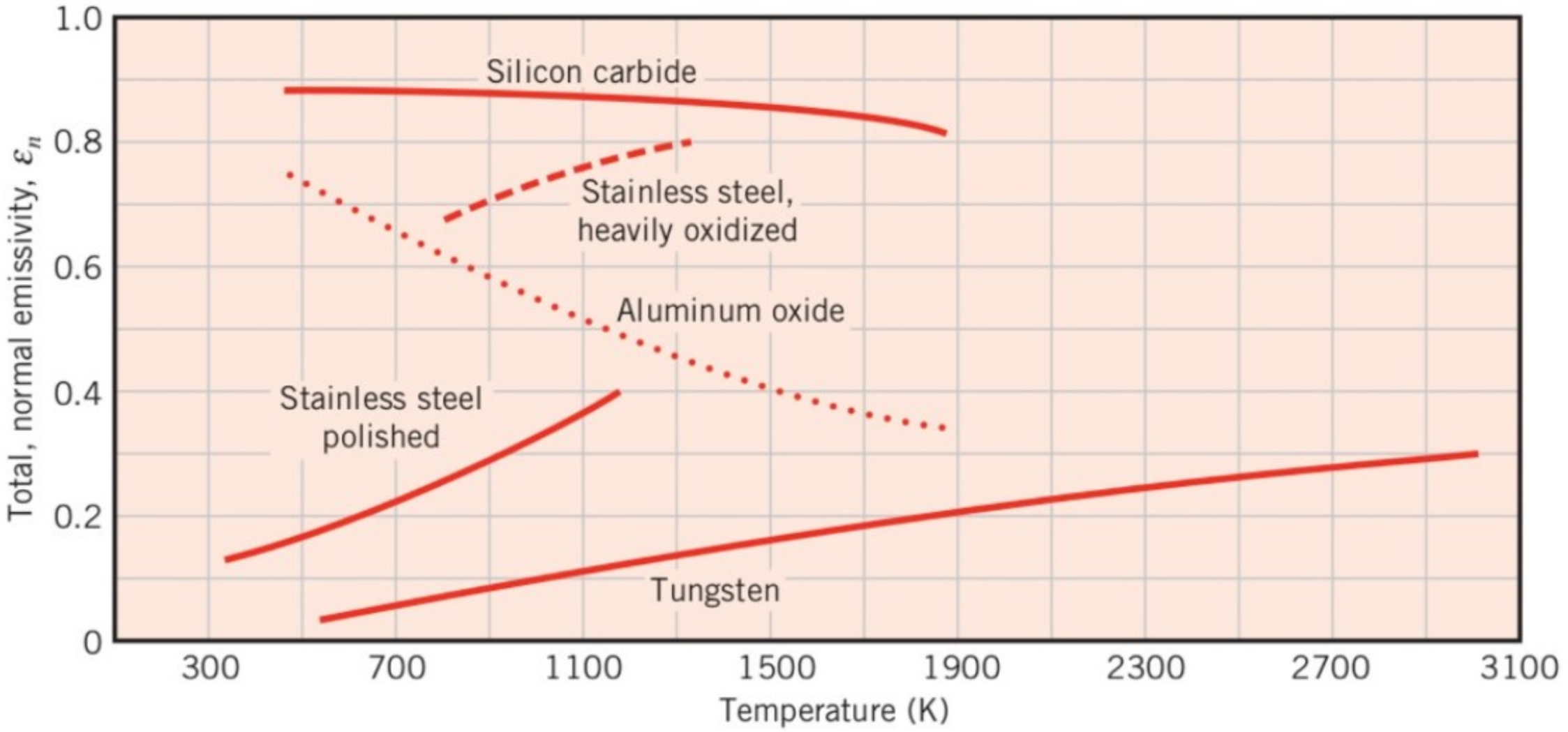
$$\varepsilon(T) = \frac{E(T)}{E_b(T)} \qquad \varepsilon \quad \text{emissivity}$$

$$E(T) = \varepsilon(T) E_b(T) = \varepsilon(T) \sigma T^4$$

$$\varepsilon_\lambda(\lambda, T) = \frac{E_\lambda(\lambda, T)}{E_{\lambda b}(\lambda, T)}$$

$$E_\lambda(\lambda, T) = \varepsilon_\lambda(\lambda, T) E_{\lambda b}(\lambda, T) = \frac{C_1 \varepsilon_\lambda(\lambda, T)}{\lambda^5 (\exp(C_2/\lambda T) - 1)}$$


Spectral, normal emissivity, $\varepsilon_{\lambda,n}$
1.0
0.8
0.6
0.4
0.2
0
0.1
0.2
0.4
0.6
1
2
4
6
10
20
40
60
100
Wavelength, λ(μm)
Silicon carbide, 1000 K
Aluminum oxide, 1400 K
Stainless steel, 1200 K heavily oxidized
2800 K Tungsten 1600 K
Stainless steel, 800 K polished


1.0
0.8
0.6
0.4
0.2
0
Total, normal emissivity, ε_n
Silicon carbide
Stainless steel,
heavily oxidized
Aluminum oxide
Stainless steel
polished
Tungsten
300
700
1100
1500
1900
2300
2700
3100
Temperature (K)

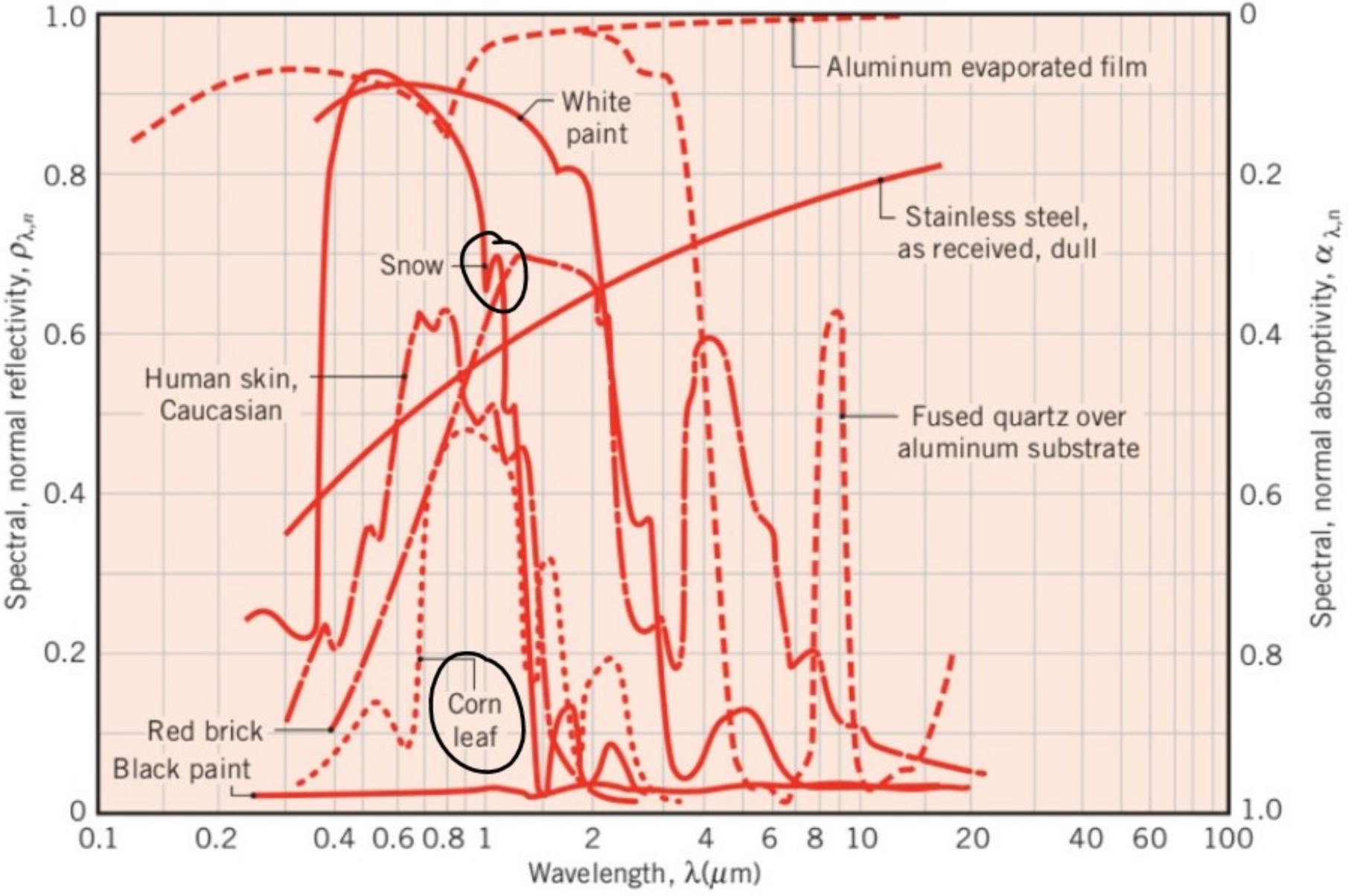
Absorptivity

$$\alpha = \frac{G_{abs}}{G}$$

$$\alpha_\lambda(\lambda) = \frac{G_{\lambda,abs}(\lambda)}{G_\lambda(\lambda)}$$

Reflectivity

$$\rho = \frac{G_{ref}}{G}$$


Aluminum evaporated film
White paint
Stainless steel, as received, dull
Snow
Human skin, Caucasian
Fused quartz over aluminum substrate
Corn leaf
Red brick
Black paint
Spectral, normal reflectivity, $\rho_{\lambda,n}$
Spectral, normal absorptivity, $\alpha_{\lambda,n}$
Wavelength, $\lambda(\mu m)$
1.0
0.8
0.6
0.4
0.2
0
0.1
0.2
0.4
0.6
0.8
1
2
4
6
8
10
20
40
60
100

Gray Surfaces

$$\varepsilon_\lambda = \alpha_\lambda$$

$$\varepsilon_\lambda = \frac{\int_0^{2\pi}\int_0^{\pi/2} \varepsilon_{\lambda,\theta} \cos\theta \sin\theta \, d\theta \, d\phi}{\int_0^{2\pi}\int_0^{\pi/2} \cos\theta \sin\theta \, d\theta \, d\phi} = \frac{\int_0^{2\pi}\int_0^{\pi/2} \alpha_{\lambda,\theta} I_{\lambda,i} \cos\theta \sin\theta \, d\theta \, d\phi}{\int_0^{2\pi}\int_0^{\pi/2} I_{\lambda,i} \cos\theta \sin\theta \, d\theta \, d\phi} = \alpha_\lambda$$

1. diffuse irradiation ($I_{\lambda,i}$ independent of θ and ϕ)

or

2. diffuse surface ($\varepsilon_{\lambda,\theta}$ $\alpha_{\lambda,\theta}$ independent of θ and ϕ)