Table 2.1 Resistivity, thermal coefficient of resistivity $\alpha_0$ at 273K (0 °C) for various metals. The resistivity index $n$ in $\rho \propto T^n$ or some of the metals is also shown.

| Metal | $\rho_0$ (n$\Omega$ m) | $\alpha_0$ (1 /K) | $n$ | Comment |
|---|---|---|---|---|
| Aluminum, Al | 25.0 | 1/233 | | |
| Antimony, Sb | 38 | 1/196 | | |
| Copper, Cu | 15.7 | 1/232 | 1.15 | |
| Gold, Au | 22.8 | 1/251 | | |
| Indium, In | 78.0 | 1/196 | | |
| Platinum, Pt | 98 | 1/255 | 0.94 | |
| Silver, Ag | 14.6 | 1/244 | 1.11 | |
| Tantalum, Ta | 117 | 1/294 | 0.93 | |
| Tin, Sn | 110 | 1/217 | 1.11 | |
| Tungsten, W | 50 | 1/202 | 1.20 | |
| Iron, Fe | 84.0 | 1/152 | 1.80 | Magnetic metal; $273 < T < 1043$K |
| Nickel, Ni | 59.0 | 1/125 | 1.72 | Magnetic metal; $273 < T < 627$K |

**Table 2.2** The effect of alloying on the resistivity

| **Material** | **Resistivity at 20 °C** <br> **n$\Omega$ m** | $\alpha_0$ **at 20 °C** <br> **1/K** |
|---|---|---|
| Nickel | 69 | 0.006 |
| Chrome | 129 | 0.003 |
| Nichrome (80%Ni-20%Cr) | 1120 | 0.0003 |

**TABLE 2.3**

Nordheim Coefficient (at 20° C) for Dilute Alloys

| Solute in Solvent (Element in matrix) | Nordheim coefficient n$\Omega$ m | Maximum Solubility at 25°C at.% |
|---|---|---|
| Au in Cu matrix | 5500 | 100 |
| Mn in Cu matrix | 2900 | 24 |
| Ni in Cu matrix | 1570 | 100 |
| Sn in Cu matrix | 2900 | 0.6 |
| Zn in Cu matrix | 300 | 30 |
| Cu in Au matrix | 450 | 100 |
| Mn in Au matrix | 2410 | 25 |
| Ni in Au matrix | 790 | 100 |
| Sn in Au matrix | 3360 | 5 |
| Zn in Au matrix | 950 | 15 |

Data extracted from various sources: Electronics Engineers' Handbook, Second Edition, ed. by D.G. Fink and D. Christiansen (McGraw-Hill, New York, 1982), section 6 (Properties of Materials by I.A. Blech), J.K. Stanley, Electrical and Magnetic Properties of Metals (American Society for Metals, Metals Park, Ohio, 1963) and Solubility data from Constitution of Binary Alloys, Second Edition, M. Hansen and K. Anderko (McGraw-Hill, New York, 1985)

Table 2.4 Hall coefficient and Hall mobility ($\mu_H = |\ \sigma R_H\ |$) of selected metals.

| Metal | $n$ [$m^{-3}$] | $R_H$ (Experimental) [$m^3\ A^{-1}\ s^{-1}$] | $\mu_H = \lvert\sigma R_H\rvert$ [$m^2\ V^{-1}\ s^{-1}$] |
|---|---|---|---|
| | $\times 10^{28}$ | $\times 10^{-11}$ | $\times 10^{-4}$ |
| Ag | 5.85 | -9.0 | 57 |
| Al | 18.06 | -3.5 | 13 |
| Au | 5.90 | -7.2 | 31 |
| Be | 24.2 | +3.4 | ? |
| Cu | 8.45 | -5.5 | 32 |
| Ga | 15.3 | -6.3 | 3.6 |
| In | 11.49 | -2.4 | 2.9 |
| Mg | 8.60 | -9.4 | 22 |
| Na | 2.56 | -25 | 53 |

[Data extracted from various sources, including *Physics Handbook*, C. Nording and J. Österman (Chartwell-Bratt Ltd., 1982)]

**Table 2.5** Typical thermal conductivities of various classes of materials at 25 °C.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pure metal | Nb | Fe | Zn | W | Al | Cu | Ag |
| $\kappa$ (W m$^{-1}$ K$^{-1}$) | 52 | 80 | 113 | 178 | 250 | 390 | 420 |
| Metal alloys | Stainless Steel | 55Cu-45Ni | 70Ni-30Cu | 1080 Steel | Bronze (95Cu-5Sn) | Brass (63Cu-37Zn) | Dural (95Al-4Cu-1Mg) |
| $\kappa$ (W m$^{-1}$ K$^{-1}$) | 12 - 16 | 19.5 | 25 | 50 | 80 | 125 | 147 |
| Ceramics and glasses | Glass-borosilicate | Silica-fused ($SiO_2$) | $S_3N_4$ | Alumina ($Al_2O_3$) | Saphire ($Al_2O_3$) | Beryllia (BeO) | Diamond |
| $\kappa$ (W m$^{-1}$ K$^{-1}$) | 0.75 | 1.5 | 20 | 30 | 37 | 260 | ~1000 |
| Polymers | Polypropylene | PVC | Polycarbonate | Nylon 6,6 | Teflon | Polyethylene low density | Polyethylene high density |
| $\kappa$ (W m$^{-1}$ K$^{-1}$) | 0.12 | 0.17 | 0.22 | 0.24 | 0.25 | 0.3 | 0.5 |

**Table 2.6** Typical resistivity values for thin metal films (polycrystalline) in microelectronics.

| Metal | Bulk ρ (Ω m) (×$10^{-8}$) | Film ρ (Ω m) (×$10^{-8}$) | Comment |
|---|---|---|---|
| Aluminum | 2.67 | 2.8 - 3.3 | Vacuum evaporated |
| Gold | 2.2 | 2.4 | Vacuum evaporated or sputtered |
| Nickel | 6.9 | 12 | Vacuum evaporated or sputtered |
| Molybdenum | 5.7 | 10 | Sputtered and annealed |

[Data from C.R.M. Grovenor, *Microelectronic Materials* (Adam Hilger, Bristol, IOP Publishing. Ltd., 1989), p.197 and K.L. Chopra and I. Kaur, *Thin Film Device Applications* (Plenum Press, New York, 1983) Chapter 4. p. 130]