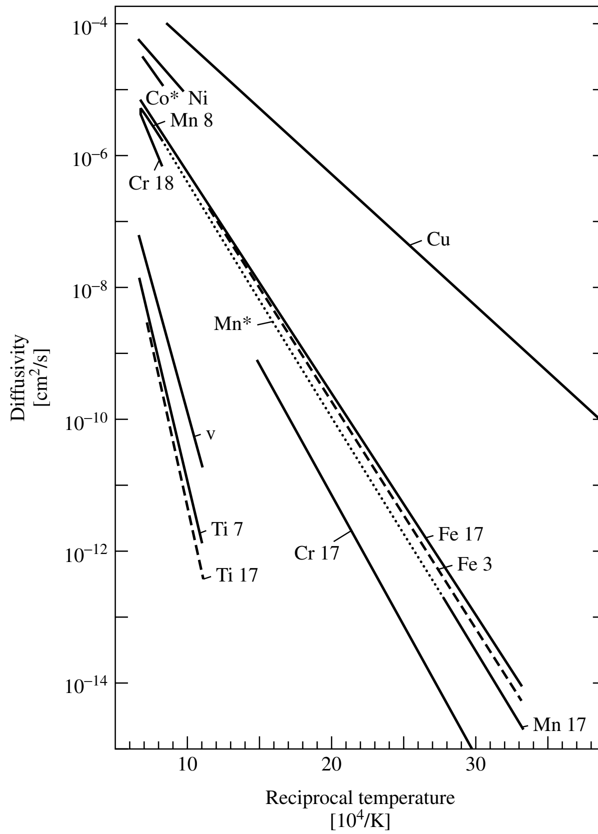

Figure 5.8 Diffusivities of 3d transition elements. Reproduced from *Metal Impurities in Silicon-Device Fabrication*, Graff K, 29, 2000, © Springer-Verlag GmbH & Co. KG

junction). The low-injection-level minority-carriers lifetime, τ_0, is inversely proportional to the impurity concentration, $N(1/\text{cm}^3)$ [28]:

$$\tau_0 = (\sigma v N)^{-1}$$

where v is the thermal velocity, which is the average speed of the electrons as they randomly collide with atoms, impurities or other defects, and σ, having the units of cm^2, represents the impurity atoms effective cross-section for the capture of a minority carrier.

Here the carrier capture cross-section for electrons, σ_e (cm^2), must be inserted for p-type silicon and σ_h for holes in n-type silicon. The thermal diffusion velocity v of electrons at room temperature is 2×10^7 cm/s.

The capture cross-sections for different transition metals can differ by several orders of magnitude. As a consequence, the carrier lifetime of a silicon sample can even be determined by an impurity of minor concentration if this is a “lifetime killer” with a high