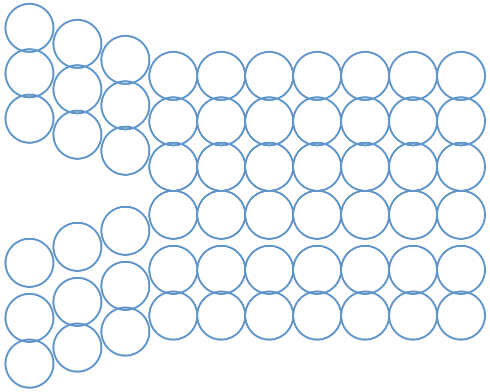
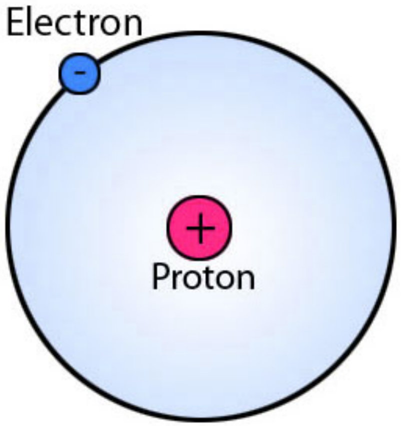
Griffith picture (1921)
Rupture of silica



$$\text{fracture energy} = \frac{\text{covalent energy of a single layer of atoms}}{\text{area}}$$

$$\Gamma \approx 1\text{J/m}^2$$

Chemical bond



Quantum mechanics
Schrodinger (1926)

$$\left[\frac{\hbar^2}{2m}\nabla^2 + \frac{e^2}{4\pi\varepsilon_o r} + E\right]\Phi = 0$$

Length

$$a = \frac{4\pi\varepsilon_o\hbar^2}{me^2} = 0.5\times10^{-10}\,\mathrm{m}$$

Energy

$$E = \frac{me^4}{2\left(4\pi\varepsilon_o\hbar\right)^2} = 13.6\mathrm{eV} = 25.8\times10^{-19}\,\mathrm{J}$$

In the above, the groups of physical quantities are obtained from dimensional considerations of the differential equation, and the numerical coefficients are for the hydrogel atom. Hydrogen atom is particularly small and the energy is particularly large.
A representative atomic size is a ~ 3 x 10^{-10} m.
A representative energy of a covalent bond is E ~ 1 eV = 1.6 x 10^{-19} J.

Surface energy

$$\gamma \sim E/a^2 \sim 1\mathrm{J/m^2}$$