Mean field analytical model. pH sensitive hydrogel.

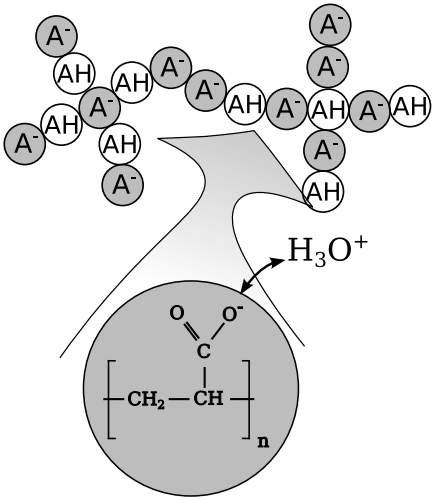

Figure 3: Each bead of hydrogel is acidic. It changes its charge depending on pH.

- ionization reaction

$$\mathrm{pAH} \overset{K}{\rightleftharpoons} \mathrm{pA^-} + \mathrm{H^+}$$

- ionization equilibrium

$$\frac{\alpha}{1-\alpha} = \frac{c^{in}_{\mathrm{H^+}}}{K} = \frac{c^{out}_{\mathrm{H^+}}}{K}\frac{c^{in}_{\mathrm{H^+}}}{c^{out}_{\mathrm{H^+}}} = 10^{pK-pH}\xi^{-1}$$

$$\frac{\alpha}{1-\alpha} = 10^{pK-pH}\left(\sqrt{1+\left(\frac{\alpha c_{\mathrm{p}}}{2c_{\mathrm{s}}}\right)^2} \mp \frac{\alpha c_{\mathrm{p}}}{2c_{\mathrm{s}}}\right)$$

- Free energy ionization term

$$F_\alpha = \alpha N\left(\ln\alpha + \ln(1-\alpha) + \ln c^{in}_{\mathrm{H^+}} - \ln K\right)$$