- vessel geometry and flow patterns. For instance, classically proportioned stirred vessel with baffles *vs.* bespoke draft tube baffle units widely used in continuous suspension crystallizers. Generally avoid conical base vessels for crystallization; these are encountered in many pilot plants because of the wide dynamic volume range and low minimum stir volume but require very intense agitation to prevent crystals settling in the base of the cone.[16,69]
- Contact secondary nucleation: crystal–wall contact[57,70]
- Secondary nucleation due to fluid shear[71,72]
- Secondary nucleation threshold[73]

Ottens *et al.*[74] developed a mechanistic description of the mechanical interaction of the crystals with the crystallizer component in which the nucleation rate of the crystals is assumed to be proportional to the collision energy and frequency of collision. Evans *et al.*[75] used the same basic approach and considered additional collision mechanisms, such as crystal–impeller collisions due to turbulence and crystal–crystal collisions induced by gravitational force. Instead of discussing the detailed model, a simpler nucleation rate model is used here:

$$B = K_{\mathrm{E}}(S)\left(K_{\mathrm{c-i}} \frac{N_{\mathrm{P}}}{P_0} k_{\mathrm{v}} \rho_{\mathrm{c}} P_{\mathrm{susp}} m_3 + K_{\mathrm{c-c}} \rho_{\mathrm{sl}} \varphi_{\mathrm{c}} \varepsilon^{5/4} L_{50}{}^4 m_0 \right) \tag{1.3}$$

where N_{P} is the Newton number of the impeller, P_0 is the power input of the stirrer, ρ is the density, P_{susp} is the minimum power required to suspend particles in the vessel, φ_{c} is the volume fraction of crystals, ε is the dissipated power by the impeller per unit mass of suspension, K_{E} is the number of nuclei per collision, $K_{\mathrm{c-i}}$ is the crystal–impeller collision constant, $K_{\mathrm{c-c}}$ is the crystal–crystal collision constant, and

$$m_3 = \int_{L_{\mathrm{c-i}}}^{\infty} L^3 n(L)\mathrm{d}L$$

$$m_0 = \int_{L_{\mathrm{c-c}}}^{\infty} n(L)\mathrm{d}L$$

where $L_{\mathrm{c-i}}$ and $L_{\mathrm{c-c}}$ are lower integration boundaries of the moments.
van Beusichem[76] developed a secondary nucleation model that considers both crystal–impeller and crystal–crystal collisions. For the crystal–impeller collisions, Ottens[74] assumed that the collision frequency, ω_{L}, of a crystal with the impeller is size independent and proportional to the circulation time, t_{c}:

$$\omega_{\mathrm{L}} \propto \frac{1}{t_{\mathrm{c}}} = \frac{K_{\mathrm{i}} N_{\mathrm{i}} D_i{}^3}{V_{\mathrm{c}}} \tag{1.4}$$