Supporting information

Derivation of equations.

The total surface free energy of a particle is

$$G_s = 6\gamma_{100} hw + 6\sqrt{3}\gamma_{001} w^2.$$

The volume of a particle is

$$V = 3\frac{\sqrt{3}}{2} w^2 h,$$

and the height can hence be expressed as a function of the volume,

$$h = \frac{2V}{3\sqrt{3}w^2}.$$

We then rewrite the expression for G_s,

$$G_s = 6w\frac{2V}{3\sqrt{3}w^2}\gamma_{100} + 3\sqrt{3}w^2\gamma_{001} = \frac{4V}{\sqrt{3}w} + 3\sqrt{3}w^2\gamma_{100},$$

and minimise the surface energy while keeping the volume constant,

$$\left(\frac{\partial G_s}{\partial w}\right)_V = -\frac{4V}{\sqrt{3}w^2}\gamma_{100} + 6\sqrt{3}w\gamma_{001} = 0$$

This gives,

$$2V\gamma_{100} = 9w^2\gamma_{001}.$$

We insert the expression for V and obtain the h/w ratio,

$$\frac{h}{w} = \sqrt{3}\frac{\gamma_{001}}{\gamma_{100}}.$$

001 faces

The excess surface free energy can be found in the following expression where κ is the bending rigidity, A is the area of the half-sphere, H_0 is the spontaneous curvature, H_{cap} is the curvature of the sphere and H_{cyl} is the curvature of the cylinder. The excess energy is thus found from the difference in making a halfsphere in the place of a cylinder.

$$G_{curv} = 2\kappa A\left[\left(H_{cap} - H_0\right)^2 - \left(H_{cyl} - H_0\right)^2\right]$$

$$H_{cap} = \frac{1}{R}$$

$$H_{cyl} = \frac{1}{2R}$$

$$A = 2\pi R^2$$

If we use these three relations we get the following equation for each cap,

$$G_{curv} = \pi\kappa\left(3 - 4RH_0\right).$$

There is one cap per unit cell and the area of a unit cell is,

$$a^2\frac{\sqrt{3}}{2}.$$

The surface energy of the 001 faces is obtained by dividing the G_{curv} with area,

$$\gamma_{001} = \frac{2G_{curv}}{\sqrt{3}a^2} = \frac{2\pi\kappa\left(3 - 4RH_0\right)}{\sqrt{3}a^2}.$$