



A New View on Kink Site Kinetics – Key for an Attempt to Unify Crystal Dissolution and Growth Theory

Andreas Lutgge (1,2) and Rolf S. Arvidson (1)

(1) Rice University, Department of Earth Science, Houston, United States (alutgge@rice.edu), (2) Rice University, Department of Chemistry, Houston, United States

Since the introduction of classical crystal models by Kossel and Stranski, the kink site has been recognized as having a central role in the kinetics of crystal growth and dissolution. The kink site is a unique surface site, defined by the property that the number of bonds that coordinate the surface atom, ion or molecule at that site is exactly half that of the same entity in the bulk crystal structure. The current view of crystal kink site kinetics assumes that dissolved components are incorporated at or depart from these sites as bonds are established or broken. For our discussion, we assume that the energies of net bond formation and cleavage at the kink site are higher (and thus rate-limiting) than those involving transport to and from the site itself. This combination of elementary reactions and basic processes drives both dissolution and growth kinetics. The conventional view of crystal dissolution and growth kinetics has typically assumed that equilibrium at kink sites is established if departure and arrival rates at these sites are equal. Furthermore, equilibrium for the entire crystal face or the entire crystal is achieved when kink sites are at equilibrium with the solution. However, this established view may require substantial revision, as we will discuss in our presentation. Reaction kinetics are significantly more complex than formerly assumed, and the analysis of the complex scenario requires a critical modification of our current model. This modification re-defines our understanding of crystal dissolution and growth theory, and lays the groundwork for a unification of both theories.