Energy landscapes in biomineral formation

PUPA U. P. A. GILBERT[1]

[1] University of Wisconsin-Madison, department of Physiscs, Materials Science, Chemistry, Geoscience.

The energy landscape of precursor mineral phases in a forming biomineral was measured for the first time by Alex Navrotsky and her group in 2010 [1]. This was and remains a milestone achievement because in forming calcite ($CaCO_3$)[2] and aragonite ($CaCO_3$)[3,4] biominerals, the enthalpy levels of precursor phases, along with and the biologically-controlled kinetic barriers between them, play a key role in producing the final biomineral. We discuss the energy landscape in diverse biominerals, either measured or deduced *a posteriori* from spectromicroscopy experiments [5-7]. Their energy landscapes are key for biominerals to become space-filling [8], tough [9], abrasion resistant [10], self-sharpening [11], or pre-stressed [12].

1. AV Radha *et al.*, Procs Natl Acad Sci (2010) DOI: doi.org/10.1073/pnas.1009959107
2. YUT Gong *et al.*, Proc Natl Acad Sci (2012) DOI: 10.1073/pnas.1118085109
3. RT DeVol *et al.*, J Am Chem Soc (2015) DOI: 10.1021/jacs.5b07931
4. T Mass *et al.*, Procs Natl Acad Sci (2017) DOI: 10.1073/pnas.1707890114
5. M Najman *et al.*, Tribol Lett (2004) DOI: doi.org/10.1007/s11249-004-8089-6
6. G De Stasio *et al.*, Clin Cancer Res (2006) DOI: 10.1158/1078-0432.CCR-05-0743
7. G Pereira *et al.*, Tribol (2007) DOI: doi.org/10.1179/175158407X189293
8. L Yang *et al.*, RSC-Nanoscale (2011) DOI: 10.1039/C0NR00697A
9. RA Metzler *et al.*, Phys Rev B (2008) DOI: dx.doi.org/10.1103/PhysRevB.77.064110
10. MA Marcus *et al.*, ACS Nano (2017) DOI: 10.1021/acsnano.7b05044
11. CE Killian *et al.*, Adv Funct Mater (2011) DOI: 10.1002/adfm.201001546
12. I Polishchuk *et al.*, Science (2017) DOI: 10.1126/science.aaj2156