Supplementary Information

Nano-Indentation

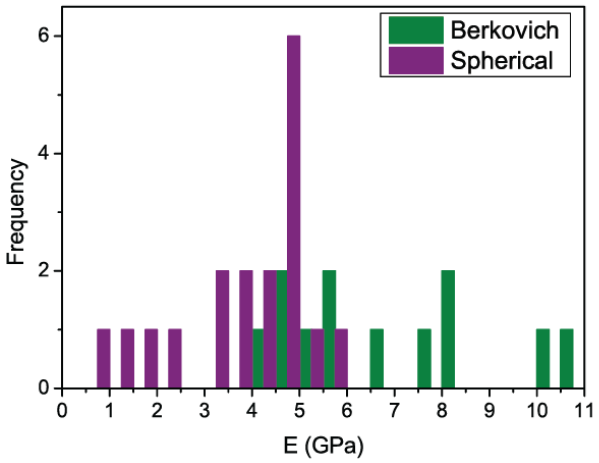

Figure S1. Histogram of elastic modulus values (E; GPa) measure using nanoindentation using both a Berkovich and a spherical tip.

Bi-Modal AFM

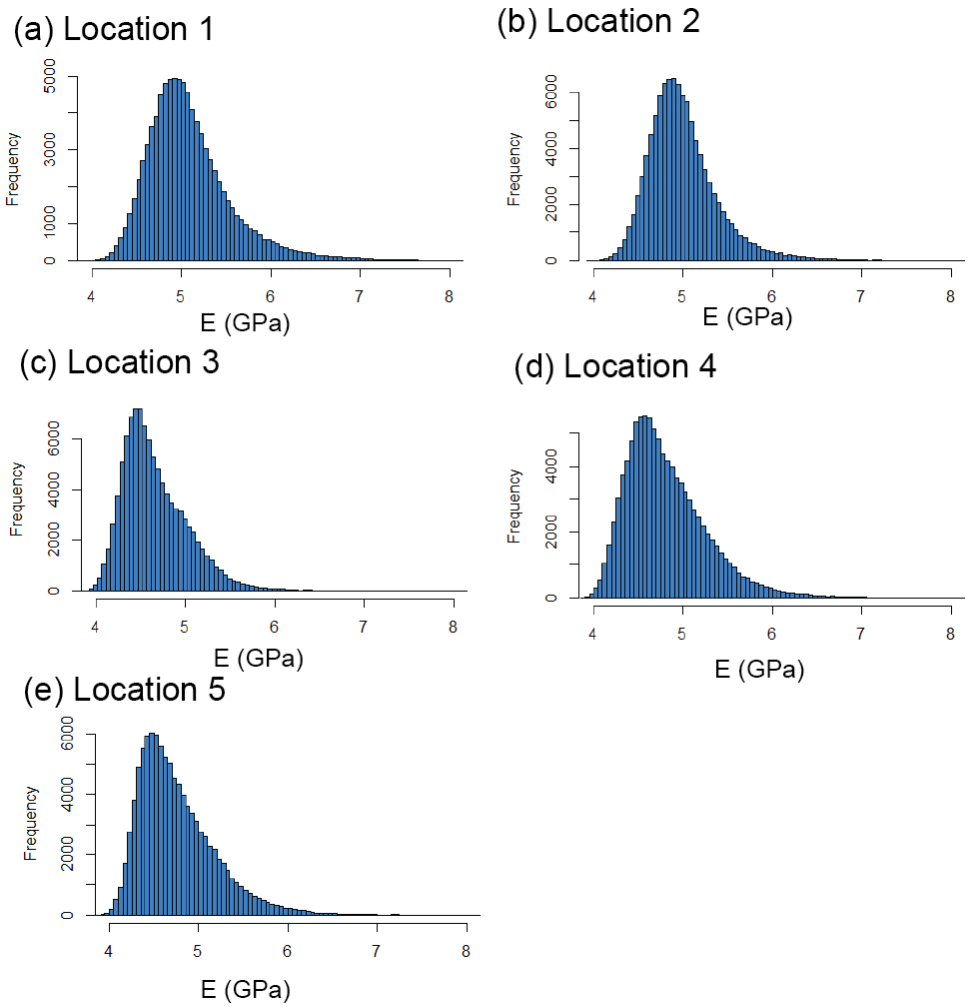

Figure S2. Histograms of elastic modulus E (GPa) values measured at five locations on the face of the $Cu(acac)_2$ crystal.

Additional Calculations

Imaging Force Calculations:

The maximum average imaging force (F_{avg}) used during the AM-AFM experiments could be approximated using the following equations;[1]

$$\mathrm{F_{avg}} = k_c A_0 \frac{4\pi^2}{3}\left(\frac{\tau}{T}\right)^2 \quad (2)$$

And:

$$\frac{\tau}{T} = \frac{arccos\left[\frac{(A_0 - \Delta A)}{A_0}\right]}{2\pi} \quad (3)$$

where, A_0 is the free liquid amplitude (~20 nm), ΔA is the change in amplitude upon surface engagement, also referred to as the damped oscillation (~4 nm – 6 nm), and K_c is the cantilever spring constant (described above). T and τ are the harmonic oscillation period and the sample contact period, respectively. Under these experimental conditions, the max F_{avg} was consistently maintained between 0.25 nN and 0.38 nN. This gives an imaging force range of 28 – 44 nN (shown in Figure S3).

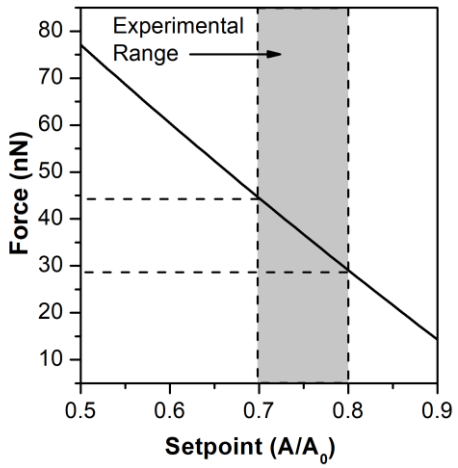

Figure S3. Calculated imaging force as a function of A/A_0. The A/A_0 range used in the experiments here is marked on the graph.

References

1 C. A. J. Putman, K. O. V. d. Werf, B. G. D. Grooth, N. F. V. Hulst and J. Greve, *Applied Physics Letters*, 1994, **64**, 2454-2456