## Supplementary Material

**Table S1. Table showing frequencies and dissipations recorded at the three different overtones. The values are obtained by averaging approximately 5 minutes of the data collected after each exchange. The average of the Δf/ΔD values from the 3rd overtone is reported.**

| Wildtype | Closed form | | | | Swollen form | | | |
|---|---|---|---|---|---|---|---|---|
| 1st exchange | | 3rd | 5th | 7th | | 3rd | 5th | 7th |
| | F | -124.89 | -120.82 | -115.21 | | -122.84 | -117.82 | -111.01 |
| | D | 8.28 | 9.07 | 9.23 | | 9.81 | 10.46 | 10.49 |
| | | | | | | | | |
| | **Δf/ΔD** | **15.08** | **13.31** | **12.48** | | **12.52** | **11.27** | **10.58** |
| | | | | | | | | |
| 2nd exchange | | | | | | | | |
| | F | -123.47 | -119.94 | -114.19 | | -122.05 | -117.56 | -110.87 |
| | D | 7.94 | 8.71 | 8.97 | | 9.37 | 9.95 | 10.10 |
| | | | | | | | | |
| | **Δf/ΔD** | **15.55** | **13.77** | **12.74** | | **13.02** | **11.82** | **10.97** |
| | | | | | | | | |

**Table S2. Table showing frequencies and dissipations recorded at the three different overtones for crosslinked CCMV. The values are obtained by averaging approximately 5 minutes of the data collected after each exchange. The average of the Δf/ΔD values from the 3rd overtone is reported.**

| **Cross-linked** | Closed form | | | | Swollen form | | | |
|---|---|---|---|---|---|---|---|---|
| 1st exchange | | 3rd | 5th | 7th | | 3rd | 5th | 7th |
| | F | -120.16 | -117.37 | -115.18 | | -118.23 | -114.27 | -111.46 |
| | D | 2.69 | 3.69 | 4.29 | | 4.03 | 5.01 | 5.58 |
| | | | | | | | | |
| | **Δf/ΔD** | **44.68** | **31.78** | **26.87** | | **29.37** | **22.82** | **19.96** |
| | | | | | | | | |
| 2nd exchange | | | | | | | | |
| | F | -118.28 | -115.71 | -113.68 | | -117.73 | -114.01 | -111.19 |
| | D | 2.28 | 3.29 | 3.89 | | 3.68 | 4.74 | 5.35 |
| | | | | | | | | |
| | **Δf/ΔD** | **51.77** | **35.13** | **29.22** | | **31.97** | **24.06** | **20.78** |
| | | | | | | | | |

**Table S3. Table showing frequencies and dissipations recorded at the three different overtones for crosslinked CCMV. The values are obtained by averaging approximately 5 minutes of the data collected after each exchange. The average of the Δf/ΔD values from the 3rd overtone is reported.**

| Mineralized | Closed form | | | | | Swollen form | | |
|---|---|---|---|---|---|---|---|---|
| 1st exchange | | 3rd | 5th | 7th | | 3rd | 5th | 7th |
| | F | -84.53 | -82.18 | -80.70 | | -92.34 | -89.82 | -88.26 |
| | D | 1.40 | 1.85 | 2.41 | | 1.67 | 2.26 | 2.89 |
| | | | | | | | | |
| | Δf/ΔD | 60.48 | 44.39 | 33.46 | | 55.35 | 39.77 | 30.55 |
| | | | | | | | | |
| 2nd exchange | | | | | | | | |
| | F | -83.43 | -81.14 | -79.88 | | -89.98 | -87.48 | -86.03 |
| | D | 1.37 | 1.84 | 2.38 | | 1.60 | 2.12 | 2.80 |
| | | | | | | | | |
| | Δf/ΔD | 60.73 | 44.08 | 33.53 | | 56.17 | 41.21 | 30.71 |
| | | | | | | | | |

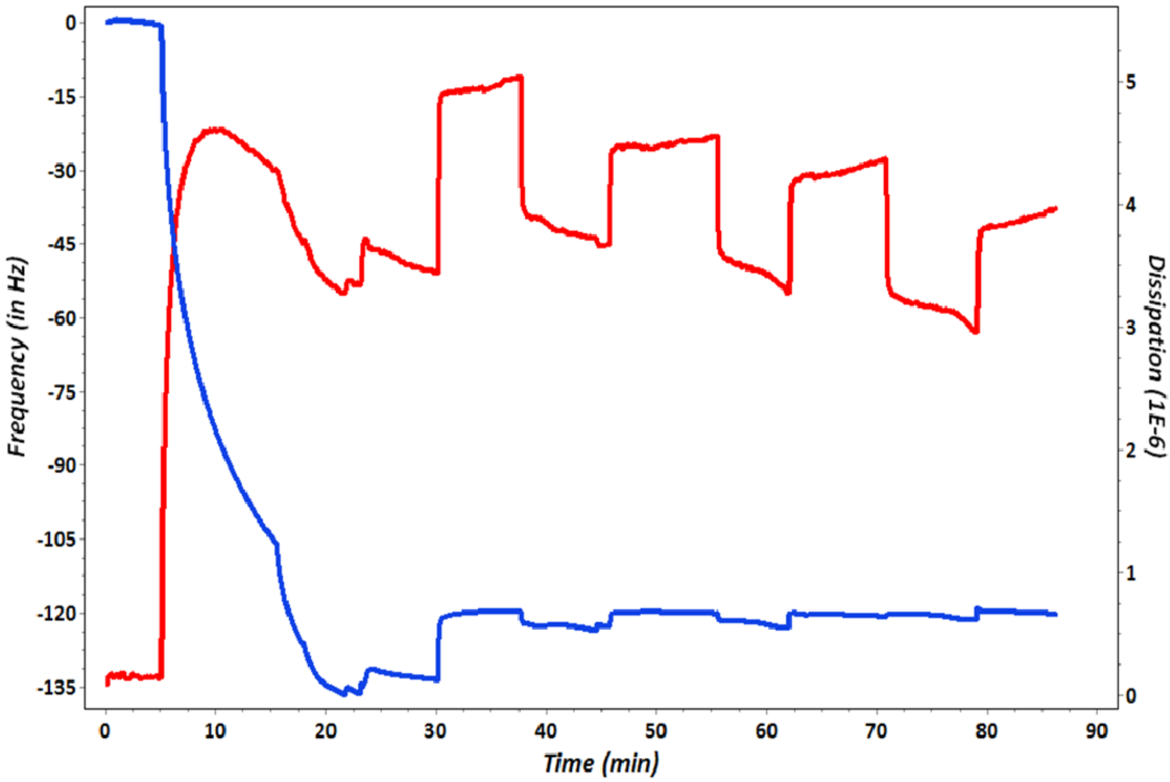


**Figure S1. QCM-D analysis of cross-linked CCMV. Trace shows the frequency (in blue, on Y1 axis) and dissipation values (in red, on the Y2 axis) of the 3rd overtone beginning with surface loading of a gold-coated crystal through multiple cycles between swollen and closed conformations. The ratio of frequency to dissipation provides information about the solution phase modulus of the material.**

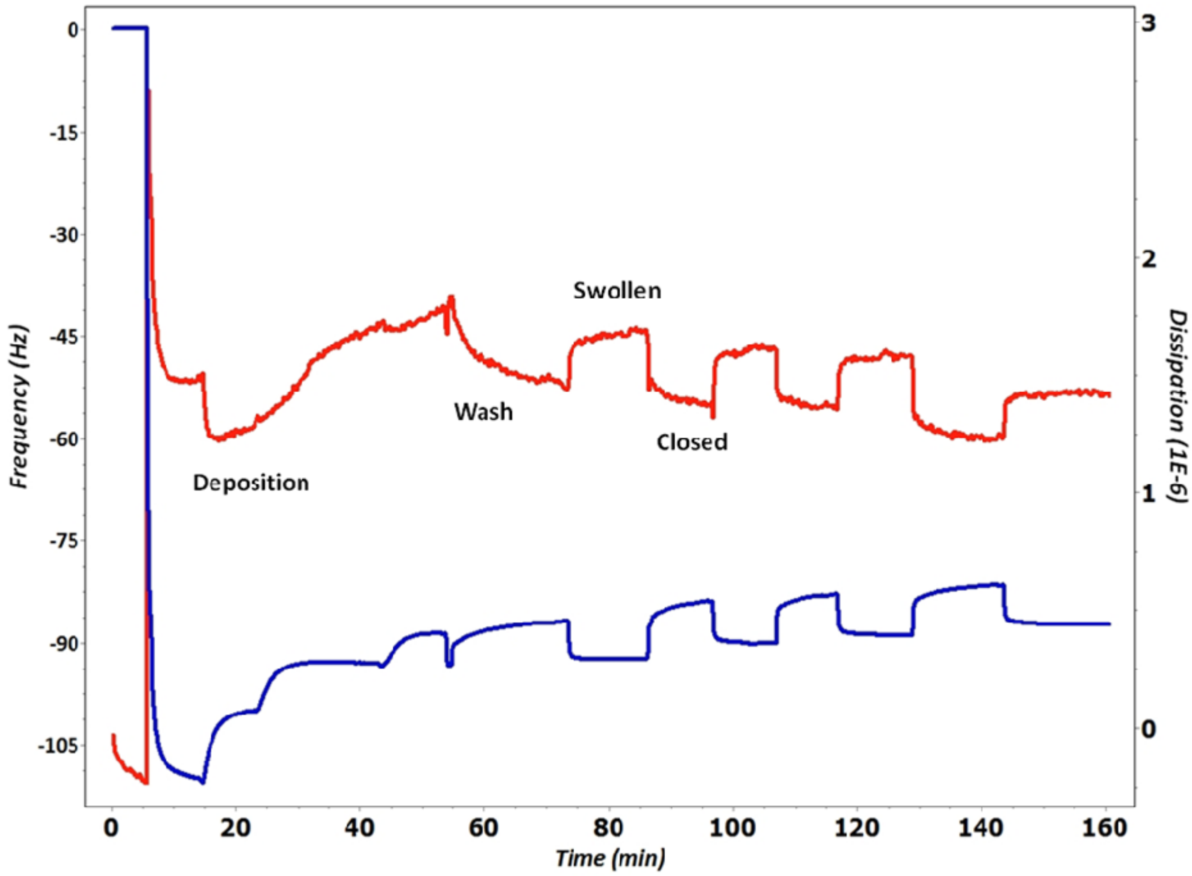


**Figure S2. QCM-D analysis of mineralized CCMV. Graph shows the frequency (in blue, on Y1 axis) and dissipation values (in red, on the Y2 axis) of the 3$^{rd}$ overtone beginning with surface loading of a gold-coated crystal through multiple cycles between swollen and closed conformations. The increase in frequency in the closed form could be due to the higher displacement of the buffer solution from the capsid interiors. Though the amount of mineral placed in the capsid is not clear, there are strong electrostatic interactions between the positive residues in the interior of the capsid and the negative mineral core. This could be a reason for this loss of buffer from the inner cavity and thereby causing the reproducible increase in frequency.**

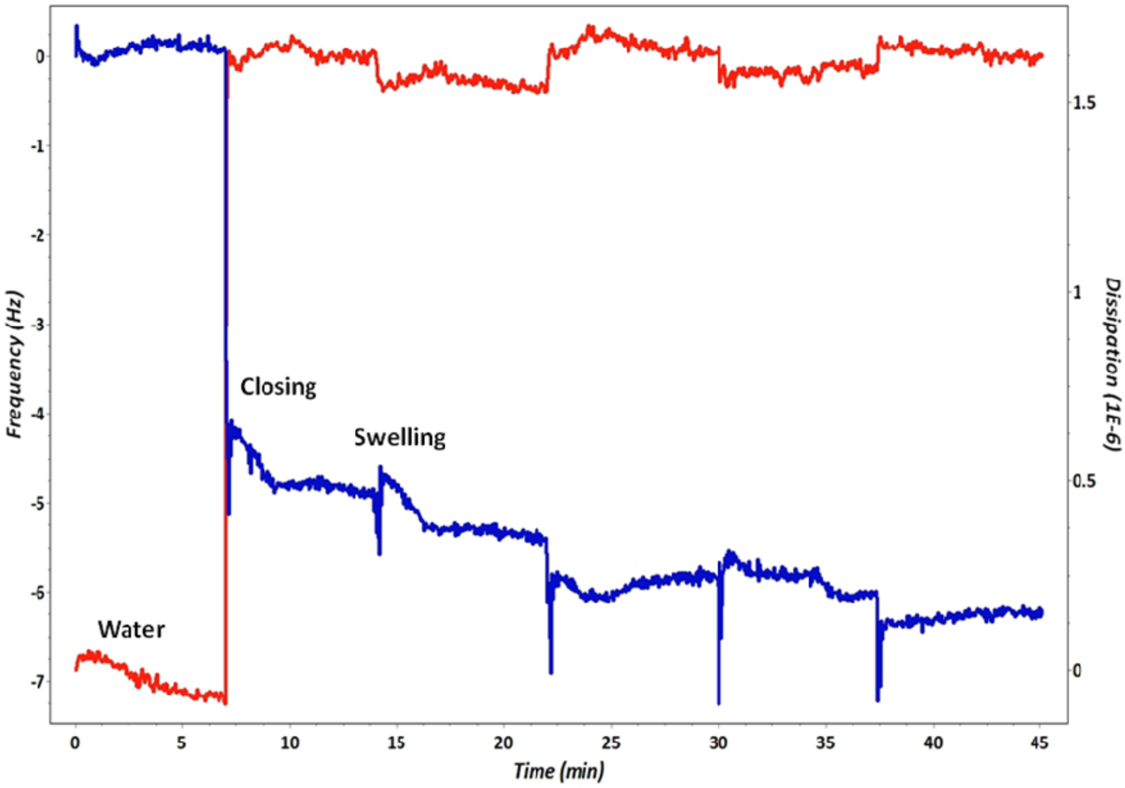


**Figure S3. Buffer exchange on bare crystal. Changes in frequency and dissipation due to buffer are negligible.**