SUPPLEMENTARY INFORMATION

Chemical bond imaging using torsional and flexural higher eigenmodes of qPlus sensors

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The Supplementary Information contains:

-Figure S1
-Figure S2
-Figure S3
-Figure S4

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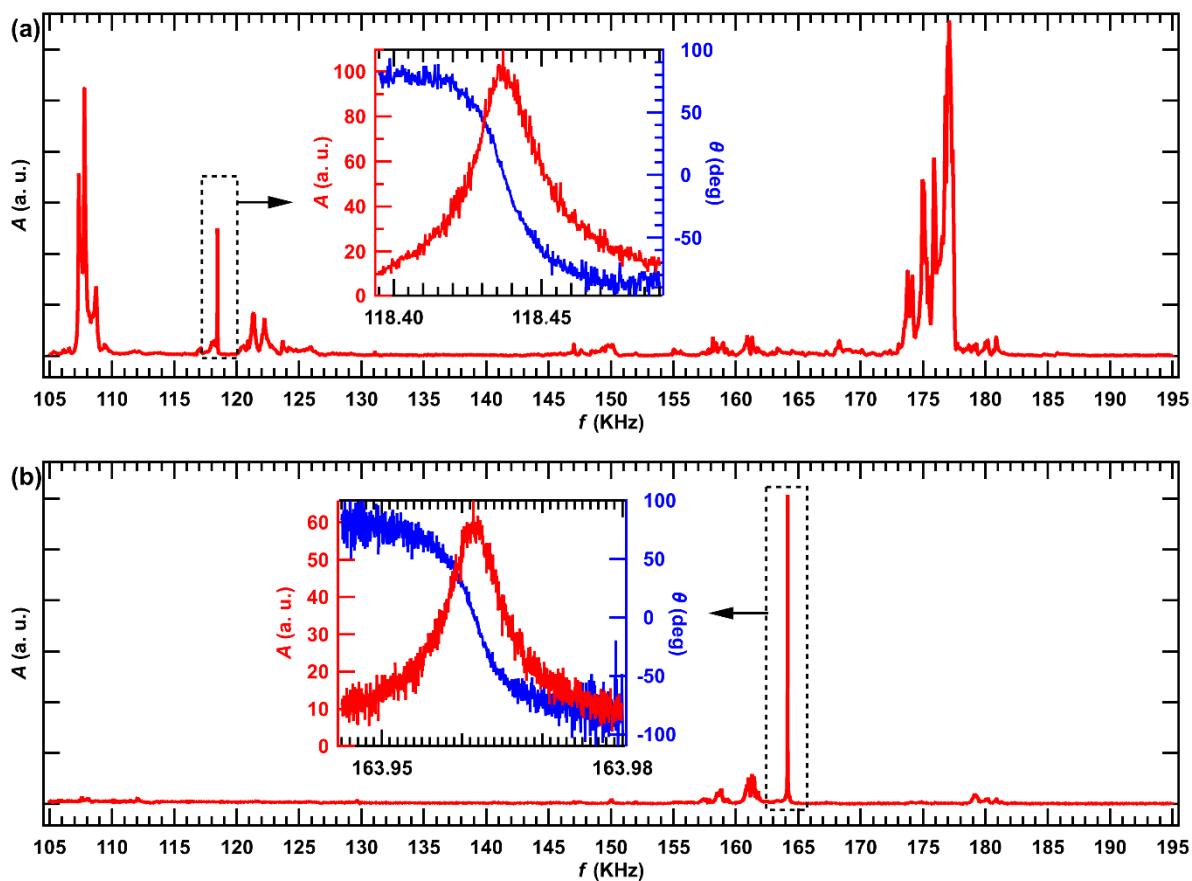
Fig. S1: (a-b) Frequency response from mechanical actuation to electrical read-out of qPlus (a) sensor 1 and (b) sensor 2 from 105 to 195 kHz measured inside the UHV LT-AFM/STM chamber at a temperature of approximately 5 K.
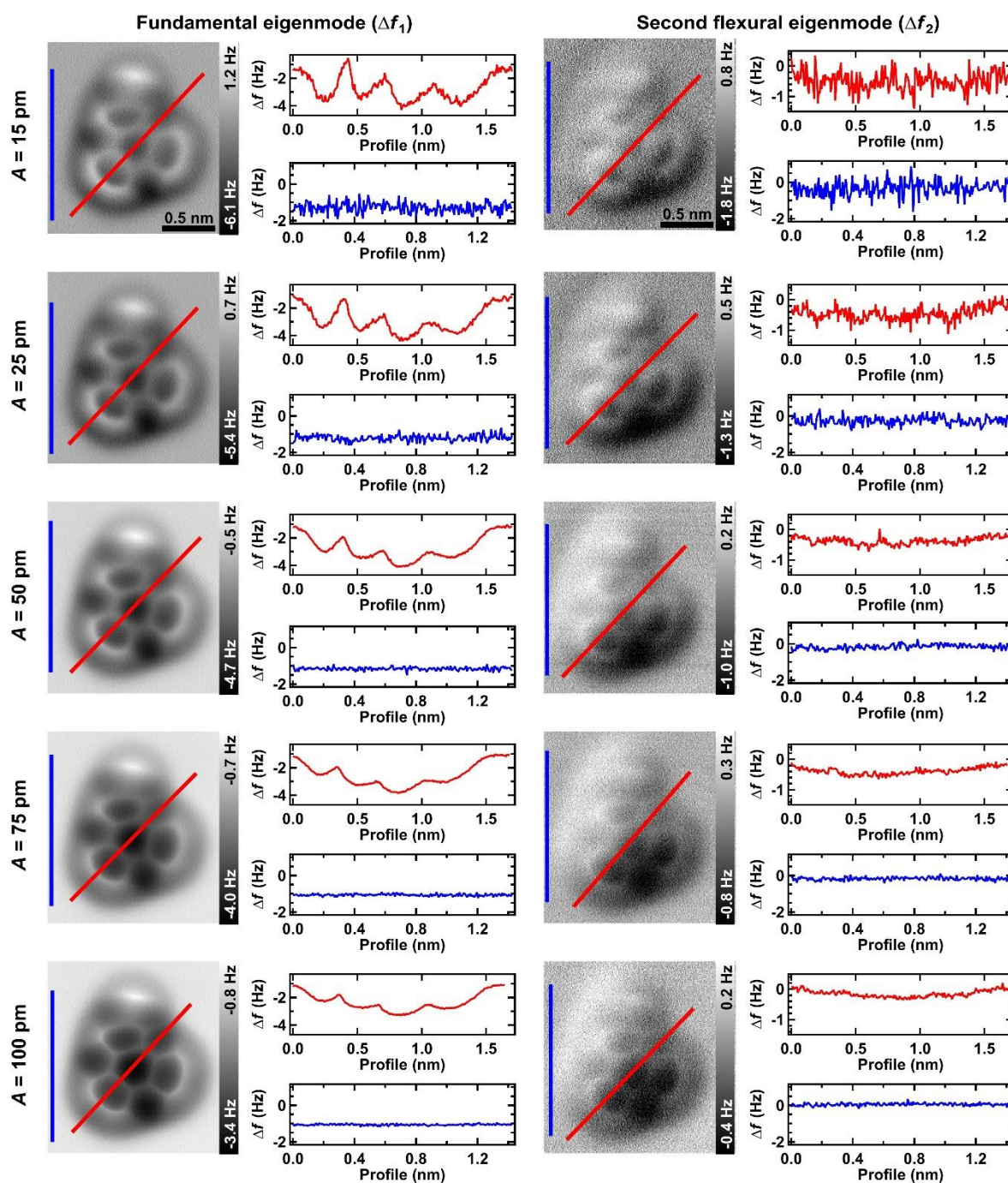
Fig. S2: Frequency shift images of ITP by actuating the fundamental and 2nd flexural eigenmode with amplitudes of 15, 25, 50, 75 and 100 pm (taken from Fig. 3b-c of the main manuscript). Profiles along the molecule in red and profiles along the Ag(111) in blue are displayed on the right side of the corresponding image.
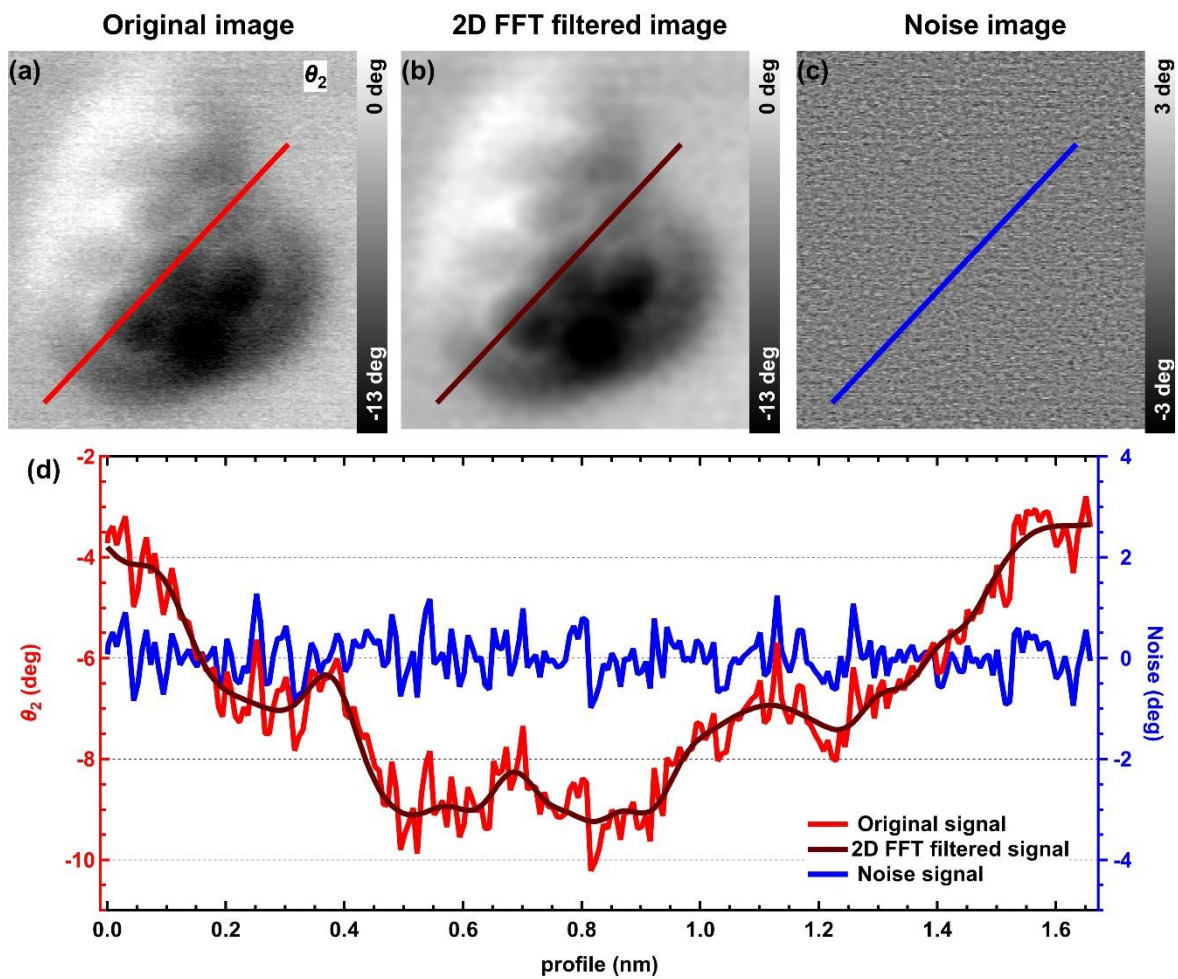
Fig. S3: (a) Original phase image at the 2nd flexural eigenmode with A = 50 pm. (b-c) Filtered phase image and noise image after applying a 2D FFT filter on image a. (d) Profiles along the molecule position (see red, maroon and blue lines in images a, b and c)
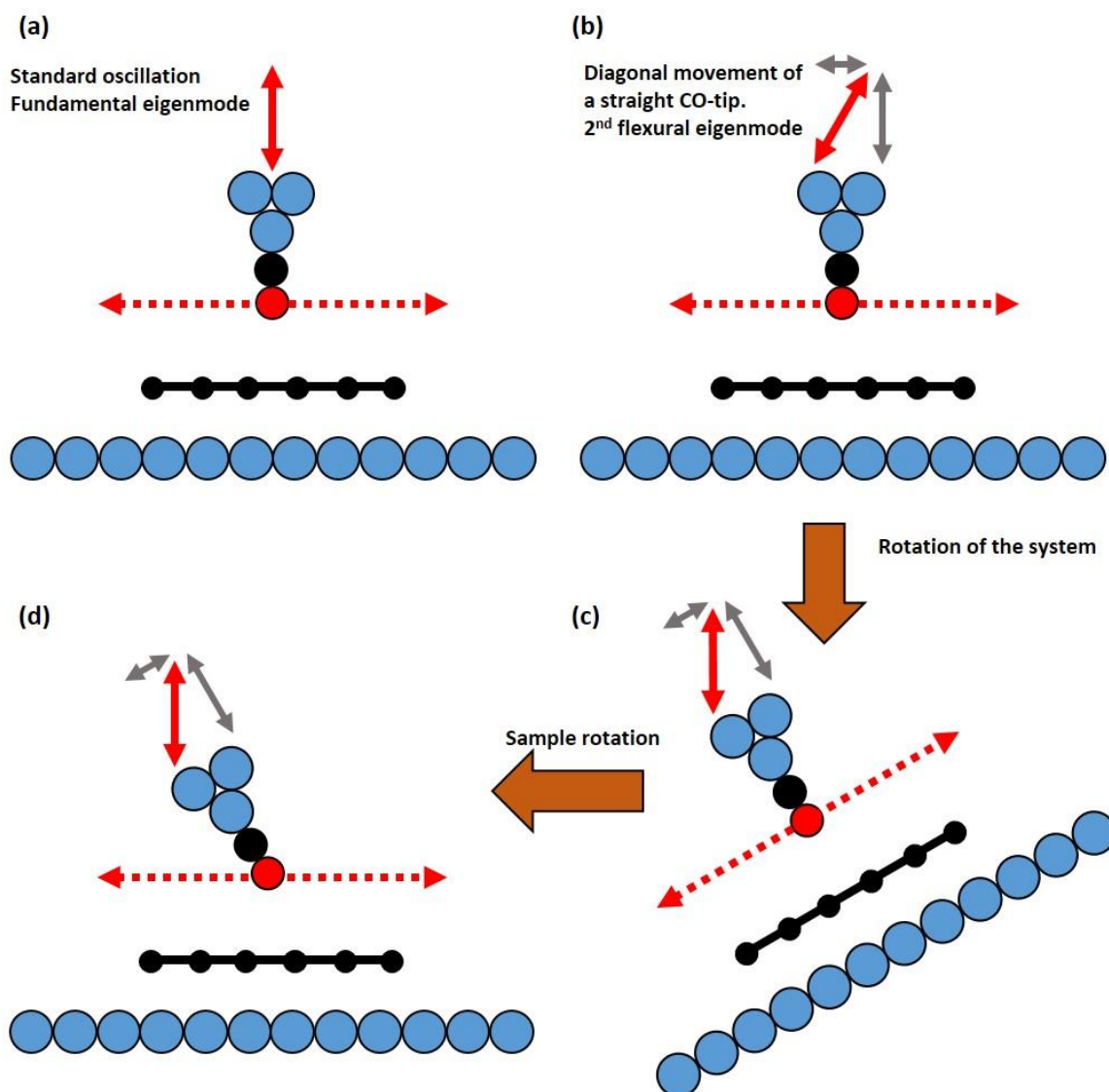
Fig. S4: The effect of a diagonal tip movement. (a) The standard situation: A straight CO-tip oscillates vertically (red solid arrow) and is scanned horizontally (red dashed arrow) above the substrate. (b) Our situation: A straight CO-tip oscillates vertically and horizontally (gray arrows). The two components are in phase, which results in a diagonal tip movement (red solid arrow). (c) A complete rotation of the system in (b) illustrates that the situation can be described as a tilted CO-tip that oscillates vertically above a tilted substrate. (d) For our AFM simulation with the Probe Particle Model we use a tilted CO-tip that oscillates vertically above a horizontal substrate. This situation is similar to the one in (c) and (b) as it only involves a different slope of the substrate surface. This slope is compensated by keeping the average tip-substrate distance constant during scanning in constant height mode (red dashed arrow).