SUPPORTING INFORMATION

VISCOELASTIC CHARACTERIZATION OF BENZO-CROWN ETHER FUNCTIONALISED ELECTROACTIVE FILMS

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Theory for acoustic resonator responses of individual physical components

Previous work quantifies the surface mechanical impedance contributions of individual components of the electrochemical system[1-3]. That for a semi-infinite Newtonian fluid (the electrolyte solution) is defined by its density (ρ_s) and viscosity (η)[1]:

$$Z_L = \left(\frac{\omega \rho_s \eta}{2} \right)^{1/2} (1 + j) \tag{S1}$$

The contribution for a "rigid" (strictly, acoustically thin) mass layer, is defined in terms of the mass per unit area (areal density, ρ_m) and resonator angular frequency (ω)[1]:

$$Z_m = j\omega\rho_m \tag{S2}$$

For a viscoelastic film, the contribution is expressed in terms of its thickness (h_f), shear modulus (***G***) and density (ρ_f)[4]:

$$Z_f = (G\rho_f)^{1/2} \tanh(\gamma h_f) \tag{S3}$$

where the shear modulus comprises real and imaginary components:

$$G = G' + jG'' \tag{S4}$$

associated with energy storage and loss, and the wave propagation constant:

$$\gamma = j\omega(\rho_f / G)^{1/2} \tag{S5}$$

The decay length of the acoustic wave within the film:

$$\delta = \frac{1}{\omega\sqrt{\rho_f}} \sqrt{\frac{2|G|}{1 - G'/|G|}} \tag{S6}$$

When $h_f > 2\delta$, there is negligible acoustic displacement at the outer film interface. The film is described as semi-infinite and the resonator response is insensitive to h_f. The hyperbolic tangent in Eqn. (S3) approaches unity and the film impedance reduces to a material (thickness independent) property, the characteristic mechanical impedance:

$$Z_0 = (G\rho_f)^{1/2} \tag{S7}$$

Figure S1: Admittance spectra acquired during the polymerisation of [Ni(3-Mesalophen-b15-c5)], *film* ***B***. Scan rate: 20 mV s^{-1}. ▬ Bare quartz/Au in deposition solution; ─ quartz/Au/polymer at the end of successive deposition cycles (arrow indicates time sequence).

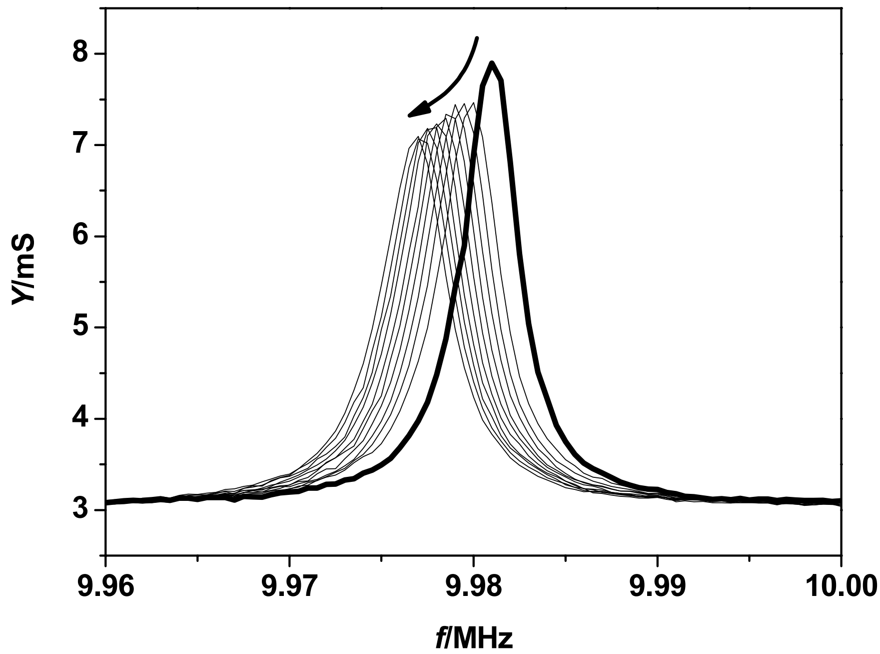
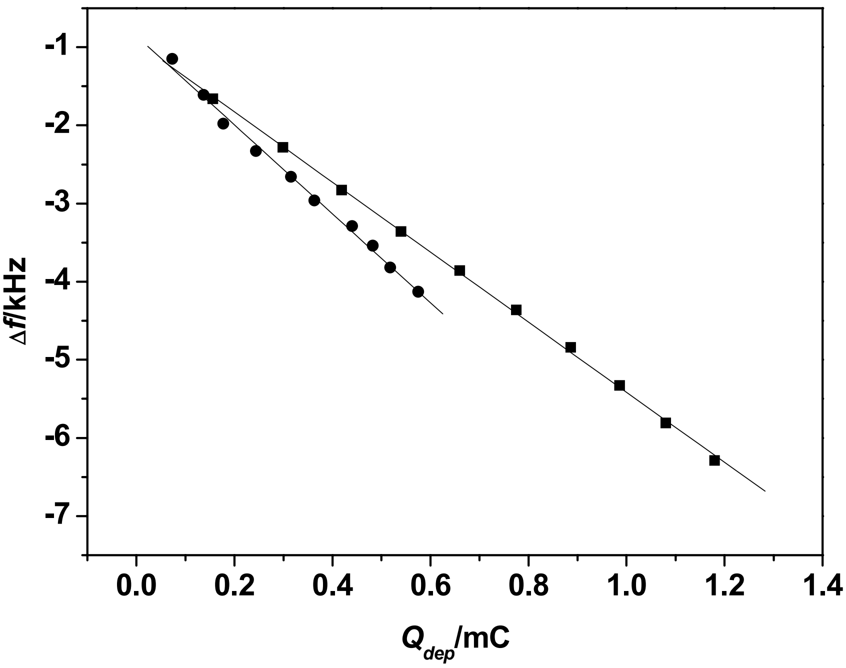


Figure S2: Analysis of acoustic resonator response during polymerisation of [Ni(3-Mesalophen-b15-c5)], to form films **A** (■) and **B** (●). Panel a: variation of resonant frequency change (with respect to that of bare electrode in solution) with deposition charge (Q_{dep}). Lines are least squares fits. Panel b: variation of resonant admittance with resonant frequency change.



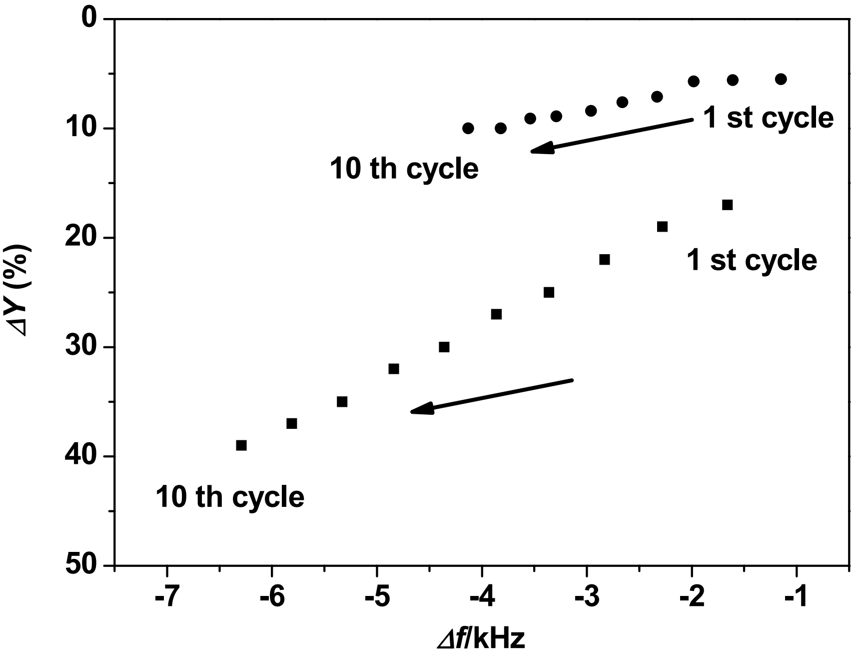
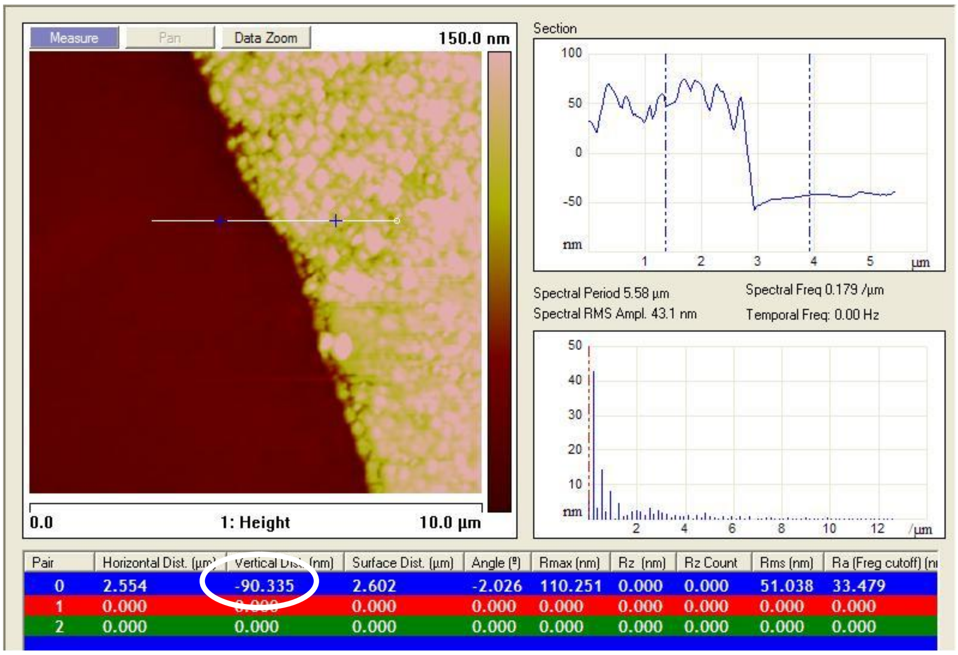
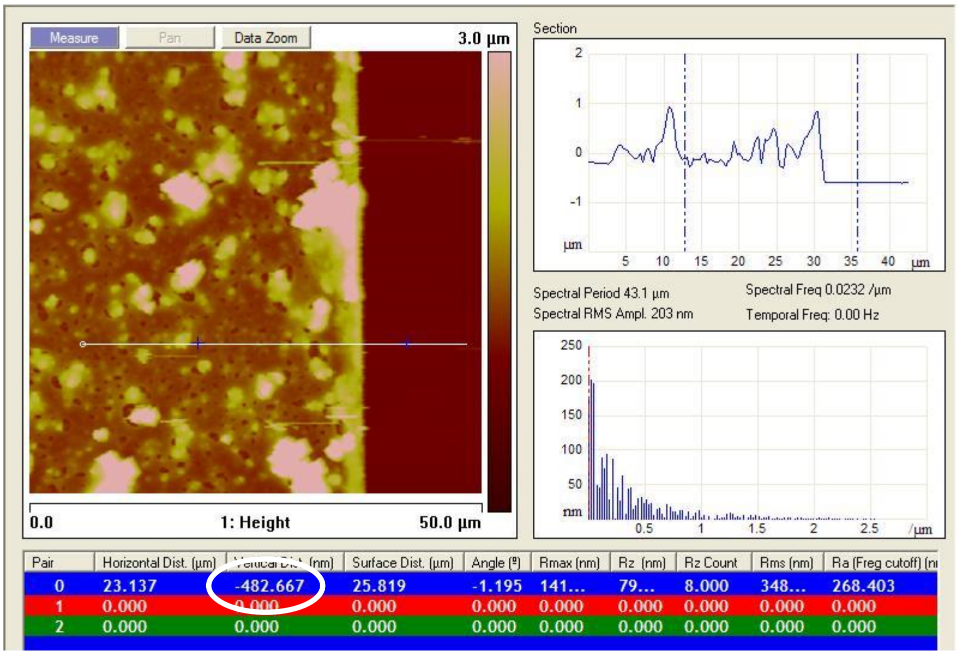


Figure S3: AFM images used to estimate h_f at cut edges of films ***E*** (panel a) and **F** (panel b).

a



b



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