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The understanding of surface degradation processes is of chief importance for the development of improved platinum (Pt) based electrocatalysts for the fuel cell application. Platinum electrocatalyst surface degrade mainly due to partial surface oxidation, surface morphology change and chemical or electrochemical dissolution. In this contribution, the first part focuses on the surface oxidation of the Pt spherical single crystal (Pt(hkl)) electrodes in 0.5 M aqueous H₂SO₄ solution and examines the influence of polarization potential (0.90 V ≤ E_p ≤ 1.50 V), polarization time (1.00 ×10⁰ s ≤ t_p ≤ 1.00 ×10⁴ s), and temperature (278 K ≤ T ≤ 318 K) on the amount of oxide coverage. The maximum oxide layer grows up to 2.5 monolayers (ML) thick and in general with an increase in E_p, t_p, T, the thicker the oxide layer becomes. The data treatment indicate that the growth of surface oxide follows two distinct kinetic laws, each arising from a different growth mechanism: (i) the logarithmic growth for surface oxide whose thickness is up to 1ML implying interfacial place-exchange mechanism, and (ii) the inverse-logarithmic growth for surface oxide whose thickness is more than 1ML implying metal cation escape mechanism. Secondly, electro-dissolution and surface morphology change of Pt(hkl) electrodes is examined under potential cycling conditions in relation to the potential cycling range (0.07 V – 1.2 V ≤ ΔE ≤ 0.07 V – 1.5 V) and the number of potential cycles (1 ≤ n ≤ 500) at a given scan rate (s = 50 mV s⁻¹) in 0.5 M aqueous H₂SO₄ solution. The surface area change during potential cycling experiments is monitored utilizing hydrogen (under-potential deposition) desorption region of the cyclic voltammetry (CV) profile and the surface morphology change is investigated using ex-situ scanning electron microscopy (SEM). The results reveal that the surface area loss is up to ~12% when conditioned at lower potential range (0.07 V – 1.20 V). On the other hand the surface area loss is only ~6% when conditioned at broader potential range (0.07 V – 1.5 V). The post experimental analysis of the electrode surface using SEM reveals that the region around Pt(531) is the least roughened, compared to other surface structures. These results ultimately bring about much needed knowledge on the relationship between the Pt surface structure and its stability in the required electrochemical environment.