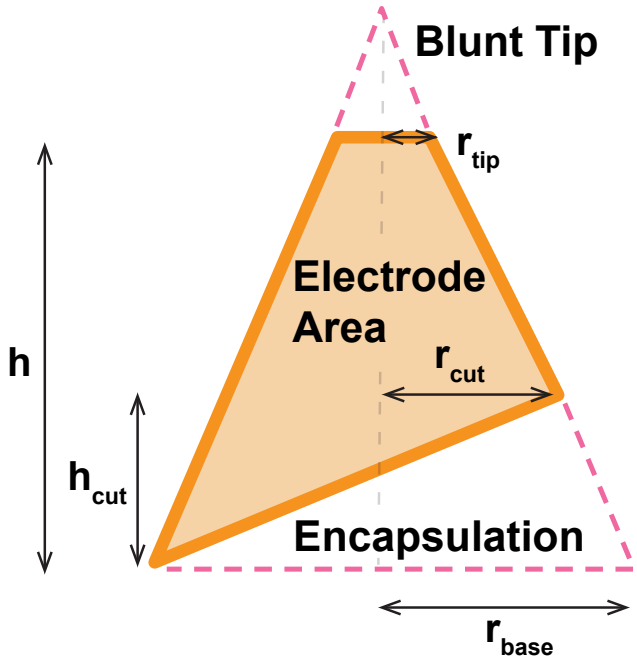
Supplemental Figures

Comprehensive Stimulation-Stability and Preclinical Testing of a New Auditory Nerve Interface

Taylor Stump et al.



$$A = \underbrace{\pi(r_{base} + r_{cut})\sqrt{(r_{base} - r_{cut})^2 + h^2}}_{\text{main frustum surface}} - \underbrace{\pi(r_{base} + r_{top})\sqrt{(r_{base} - r_{top})^2 + (h - h_{top})^2}}_{\text{bottom wedge surface}} \quad (1)$$

Figure S1: Cross-section of the electrode tip metallization showing the labeled dimensions used for the surface area calculation in Equation 1. The encapsulated or possible chipped (pink) areas are removed from the exposed surface area (orange) calculation. Here, r_{base}, r_{top}, and r_{cut} denote the base and top cut radii of the encapsulation angle, and the possible tip-cut radii, respectively; h is the axial length from the tip to the base; and h_{cut} is the axial length from most distal edge of tip metallization exposure, to the most proximal.

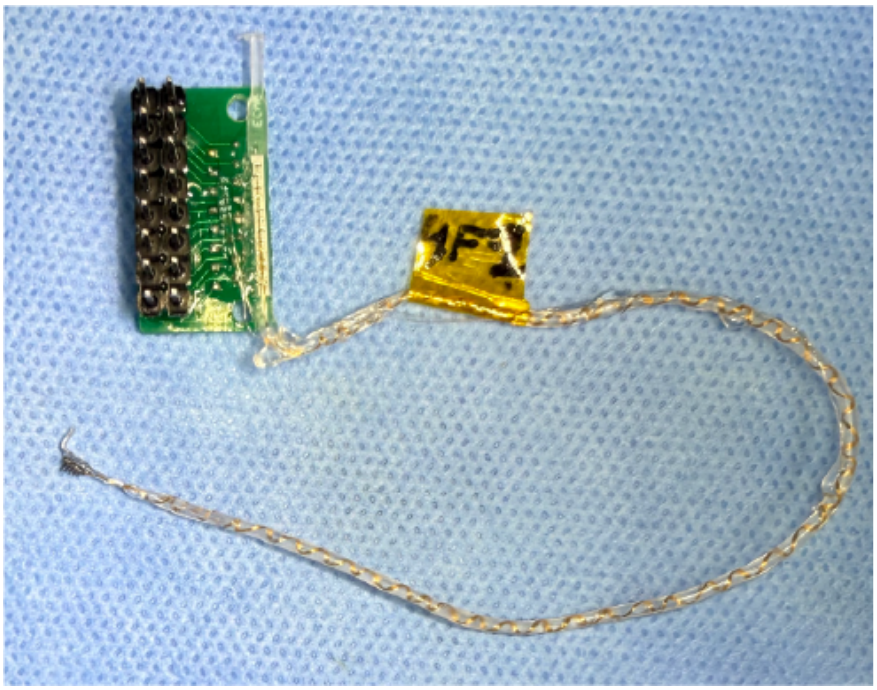


Figure S2: AN-USA Assembly of reference device with solder integrated pin header for bench measurements. Electrodes n=8 of the total 12 electrodes were used in the electrochemical impedance spectroscopy, cyclic voltammetry , and voltage transient baseline characteristics.

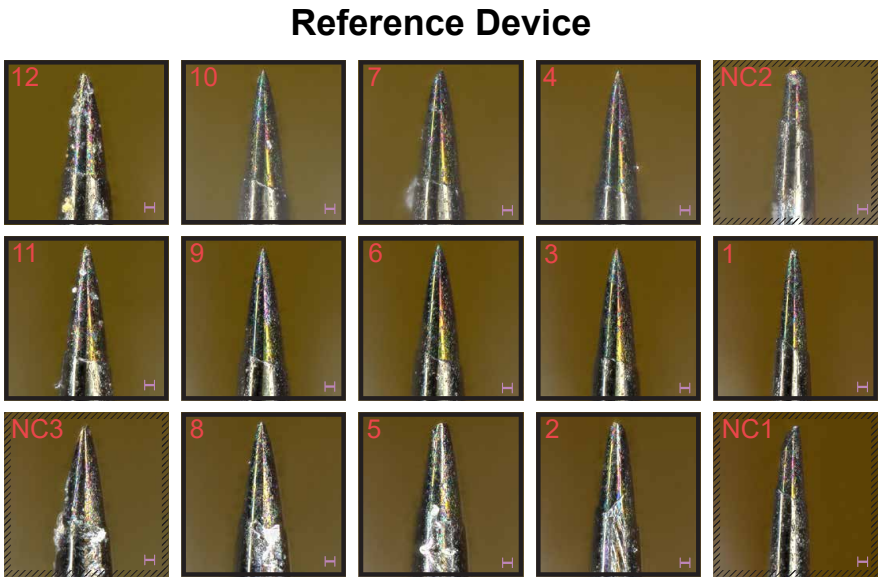


Figure S3: Electrode BSEM Tine tip images of AN-USA Assembly reference device with exposed pin header. Electrodes K1-3, K5-9 (n=8) were the electrodes used for baseline electrochemical characterization. All scale bars are 10 μm.

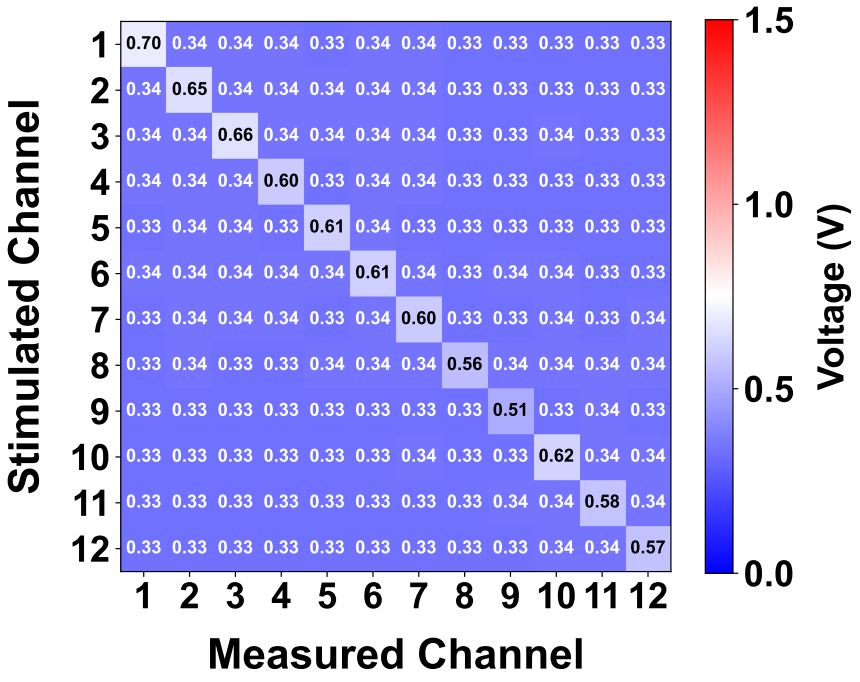


Figure S4: Initial measured voltage matrix from Device 6 before 100 μA biphasic stimulation pulses. Stimulated electrode number is on the y axis, and voltage is recorded from electrodes on the x axis. On diagonal values are used to evaluate an electrodes impedance, and are the reported values in text. Off-diagonal voltages are not reported, but are used to help diagnose other possible failure mechanisms via spreading current such as a broken lead wire or a short cut.

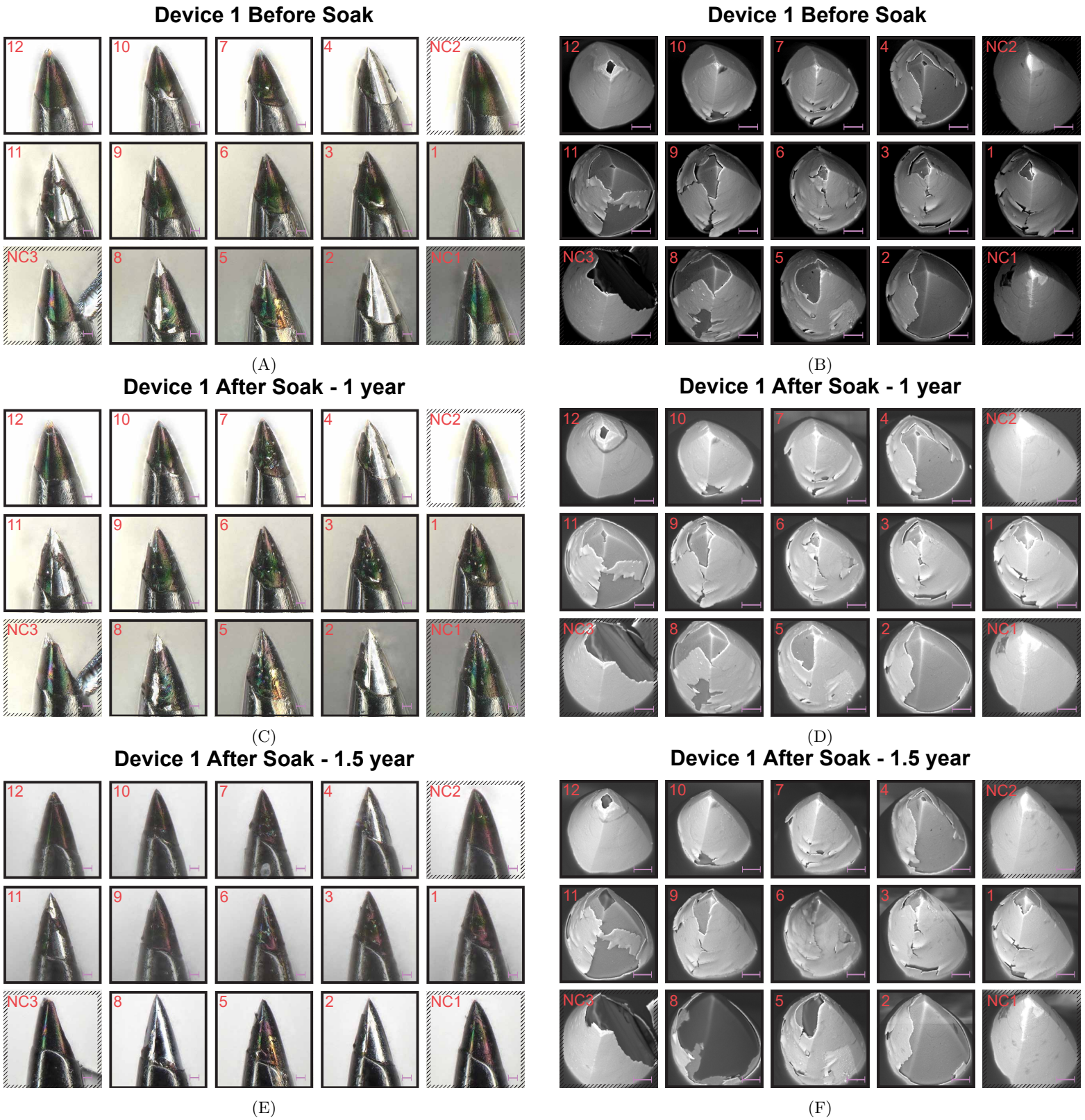


Figure S5: Device 1 Before and after Optical (left column) and Back Scattered Scanning Electron Microscopy (right column) micrographs after thermal accelerated aging. Optical micrographs were taken with a 500× magnification, while the BSEM micrographs are a 1250× magnification. All scale bars are 10 μm. **(A)** Optical before TAA. **(B)** BSEM before TAA. **(C)** Optical after 1 year TAA. **(D)** BSEM - after 1 year TAA. **(E)** Optical after 1.5 year TAA. **(F)** BSEM after 1.5 year TAA.

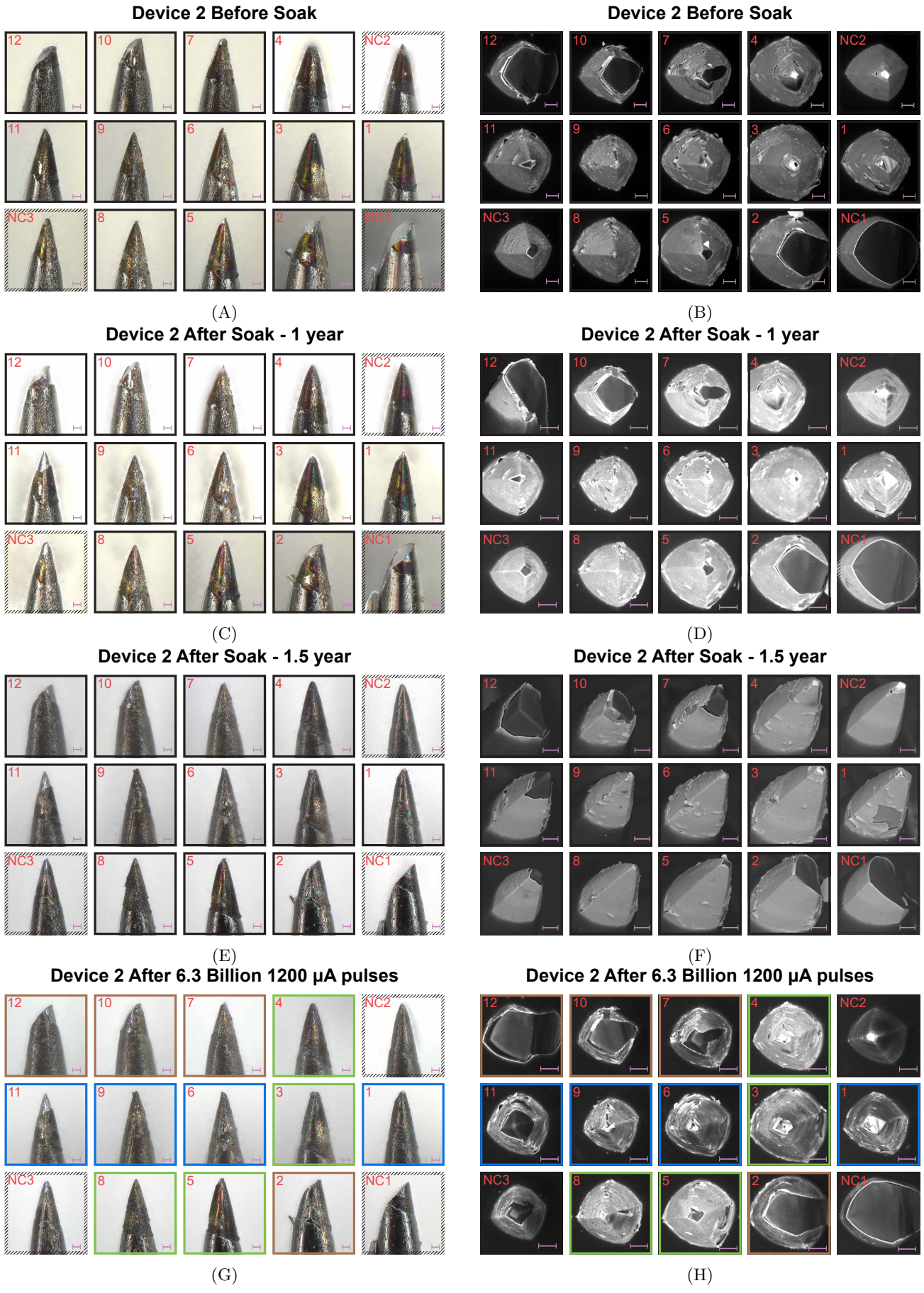
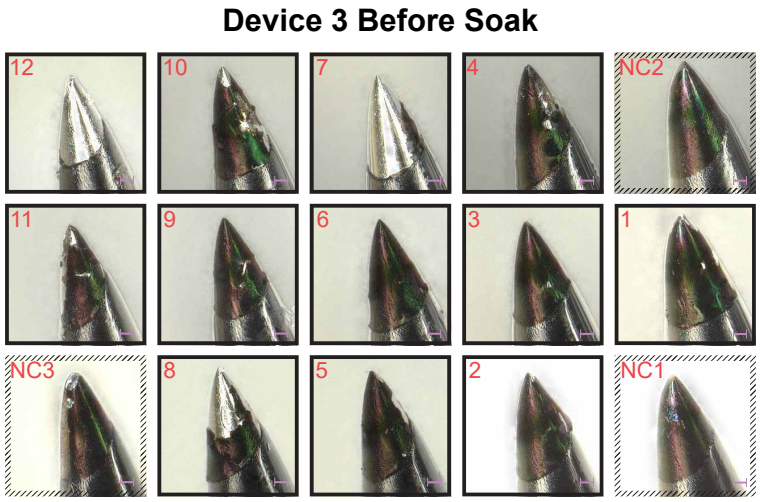
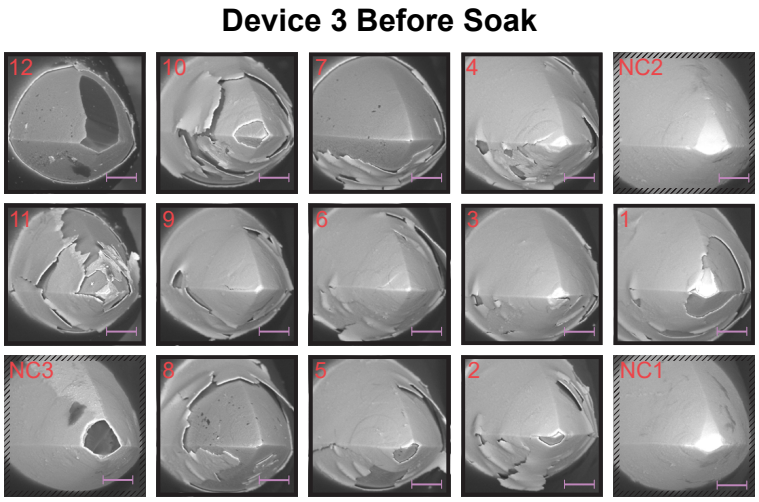


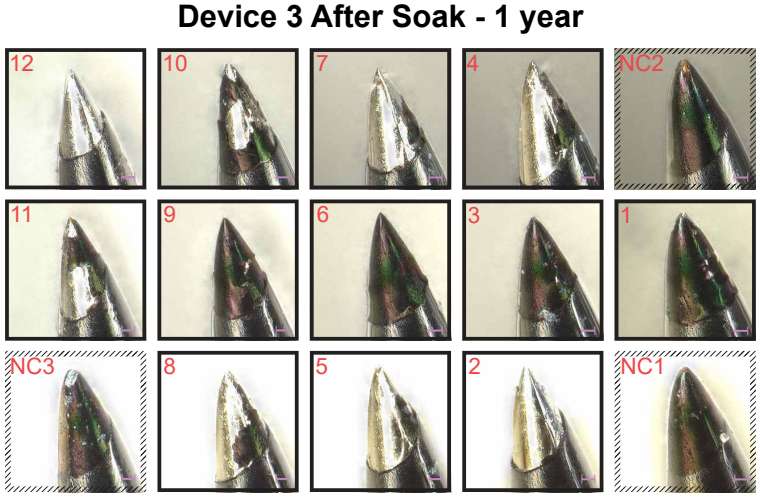
Figure S6: Device 2 Before and after Optical (left column) and Back Scattered Scanning Electron Microscopy (right column) micrographs after thermal accelerated aging and 1200 μA high intensity Stim-Stab . Optical micrographs were taken with a 500× magnification, while the BSEM micrographs had a 1250× magnification. All scale bars are 10 μm. **(A)** Optical before TAA. **(B)** BSEM before TAA. **(C)** Optical after 1 year TAA. **(D)** BSEM - after 1 year TAA. **(E)** Optical after 1.5 year TAA. **(F)** BSEM after 1.5 year TAA. **(G)** Optical after 1200 μA Stim-Stab. **(H)** BSEM after 1200 μA Stim-Stab.



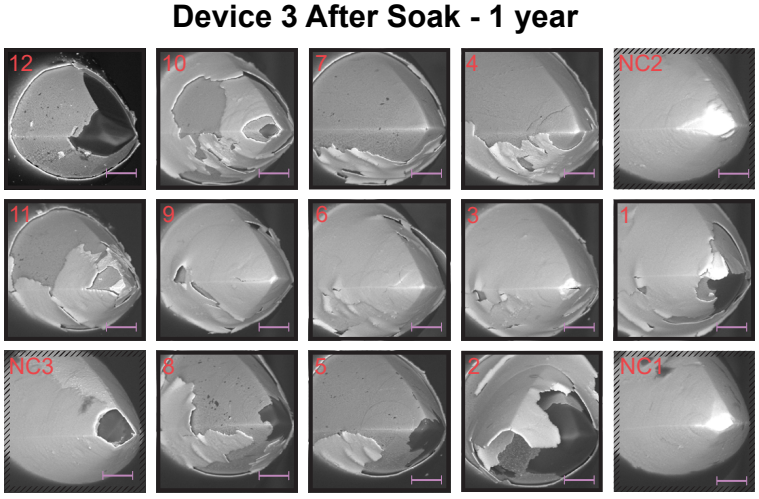
(A)



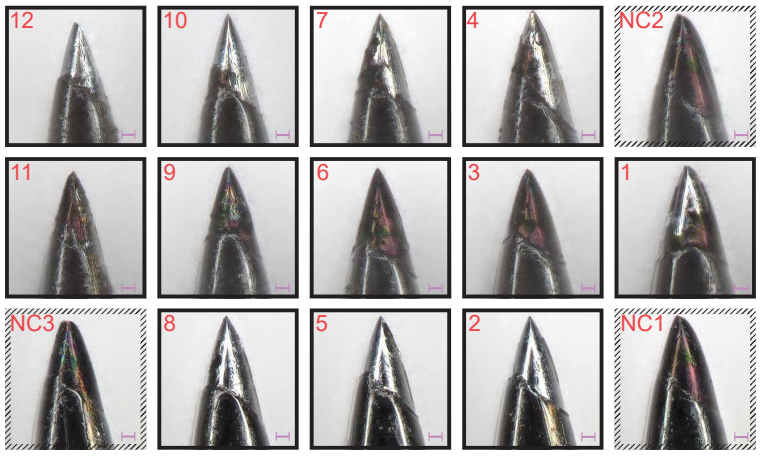
(B)



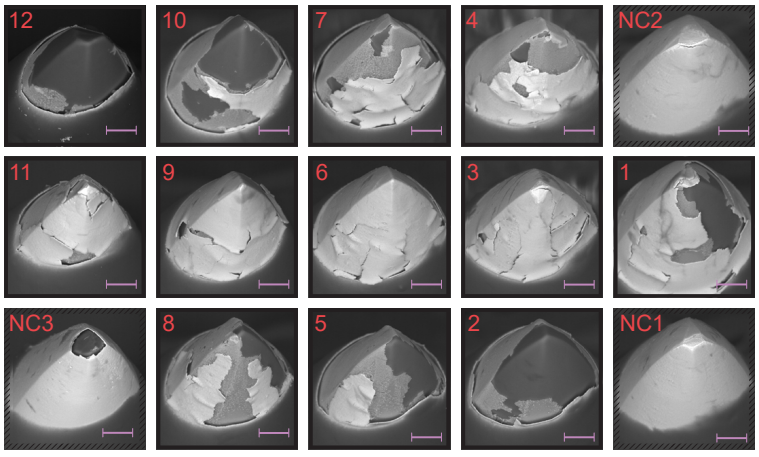
(C)



(D)



(E)



(F)

Figure S7: Device 3 Before and after Optical (left column) and Back Scattered Scanning Electron Microscopy (right column) micrographs after thermal accelerated aging. Optical micrographs were taken with a 500× magnification, while the BSEM micrographs had a 1250× magnification. All scale bars are 10 μm. **(A)** Optical before TAA. **(B)** BSEM before TAA. **(C)** Optical after 1 year TAA. **(D)** BSEM - after 1 year TAA. **(E)** Optical after 1.5 year TAA. **(F)** BSEM after 1.5 year TAA.

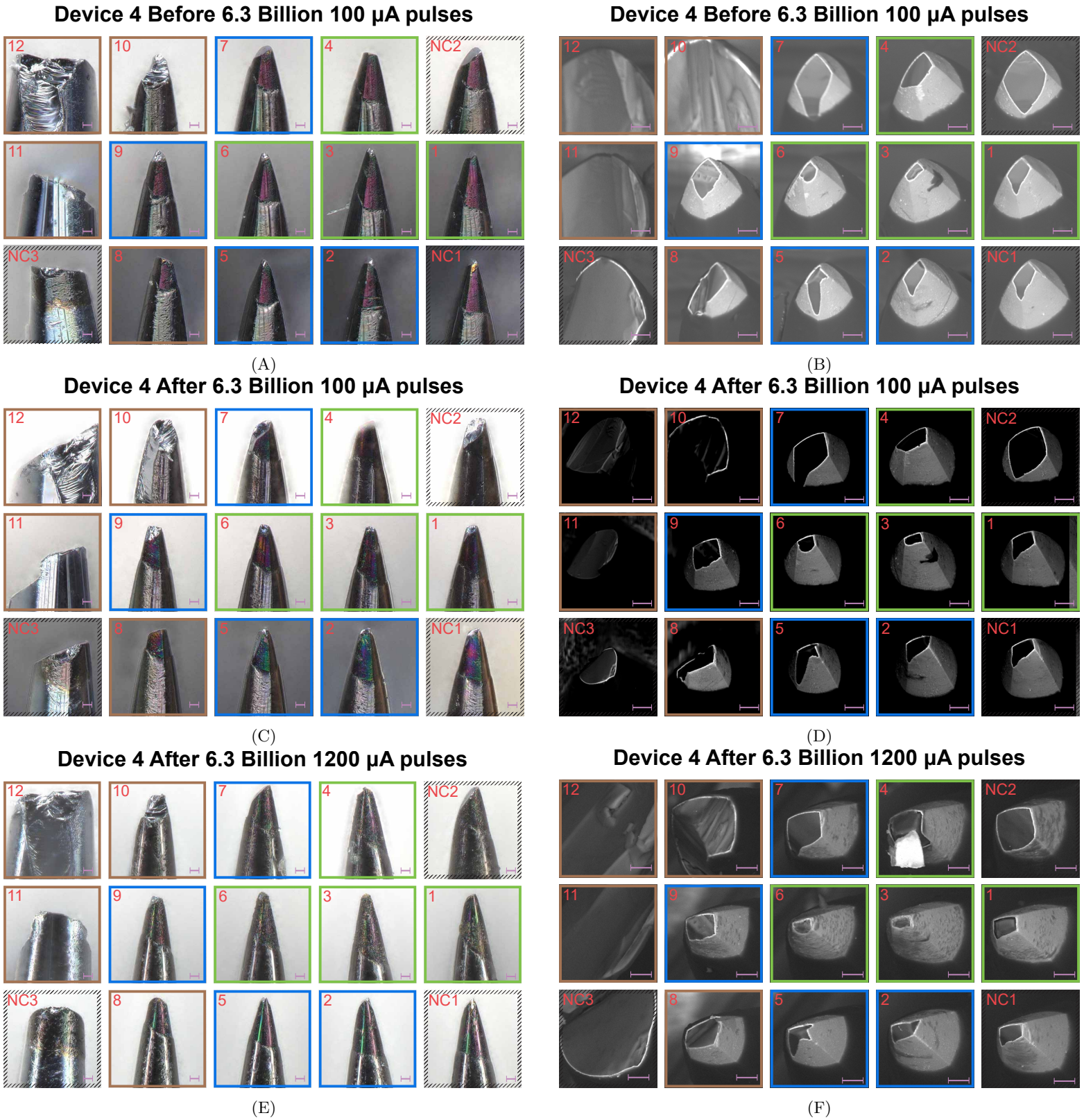


Figure S8: Device 4 Optical (left column) and Back Scattered Scanning Electron Microscopy (right column) micrographs before and after thermal accelerated aging. Optical micrographs were taken with a 500× magnification, while the BSEM micrographs had a 1250× magnification. All scale bars are 10 μm. **(A)** Optical before TAA. **(B)** BSEM before TAA. **(C)** Optical after 1 year TAA. **(D)** BSEM - after 1 year TAA. **(E)** Optical after 1.5 year TAA. **(F)** BSEM after 1.5 year TAA.

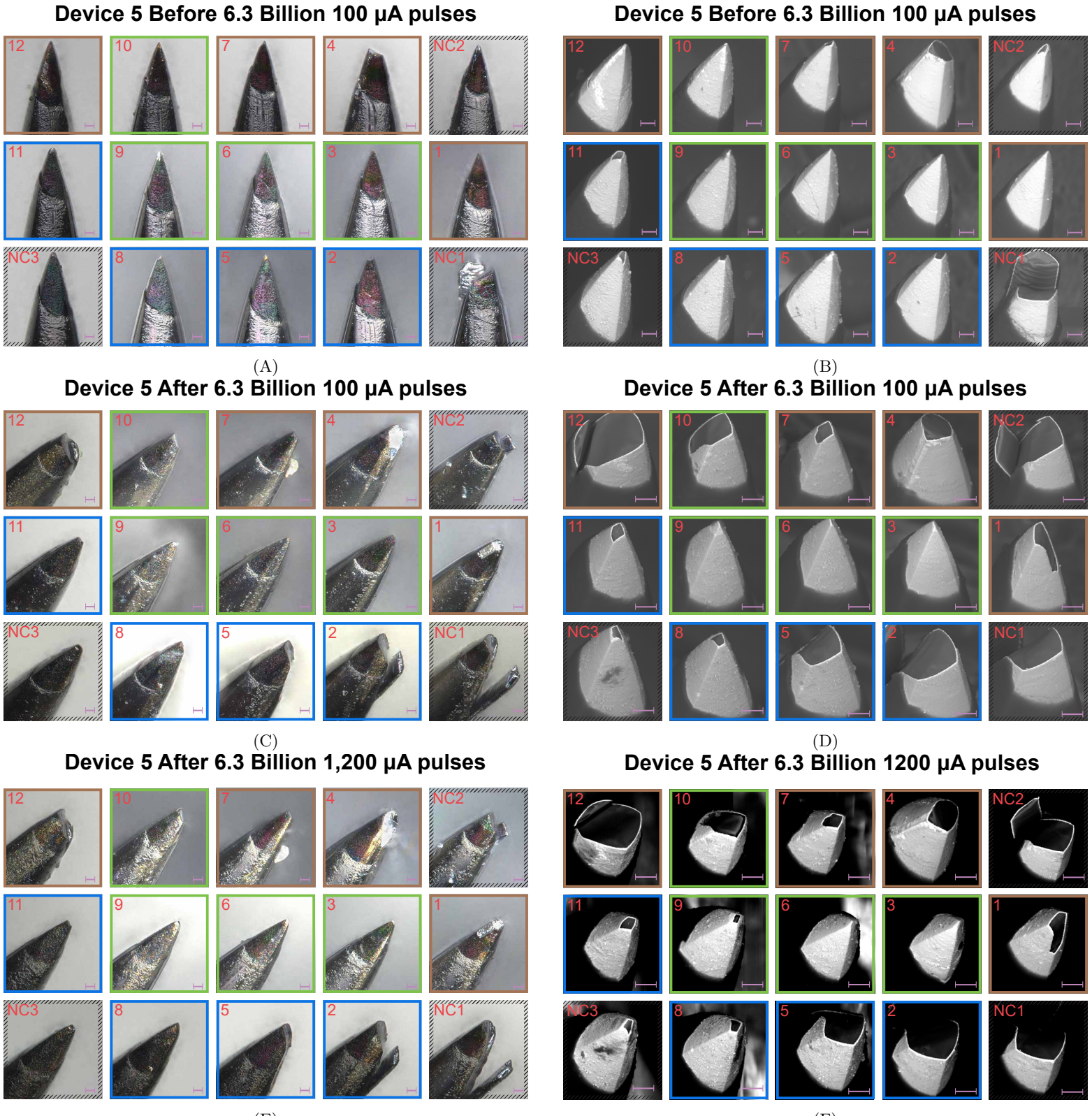


Figure S9: Device 5 Before and after Optical and Back Scattered Scanning Electron Microscopy 500× magnification images of all 15 electrodes in the same orientation as Figure 1. **(A)** Optical before TAA. **(B)** BSEM before TAA. **(C)** Optical after 100 μA stimulation. **(D)** BSEM after 100 μA stimulation. **(E)** Optical after 1,200 μA stimulation. **(F)** BSEM after 1,200 μA stimulation. All scale bars are 10 μm

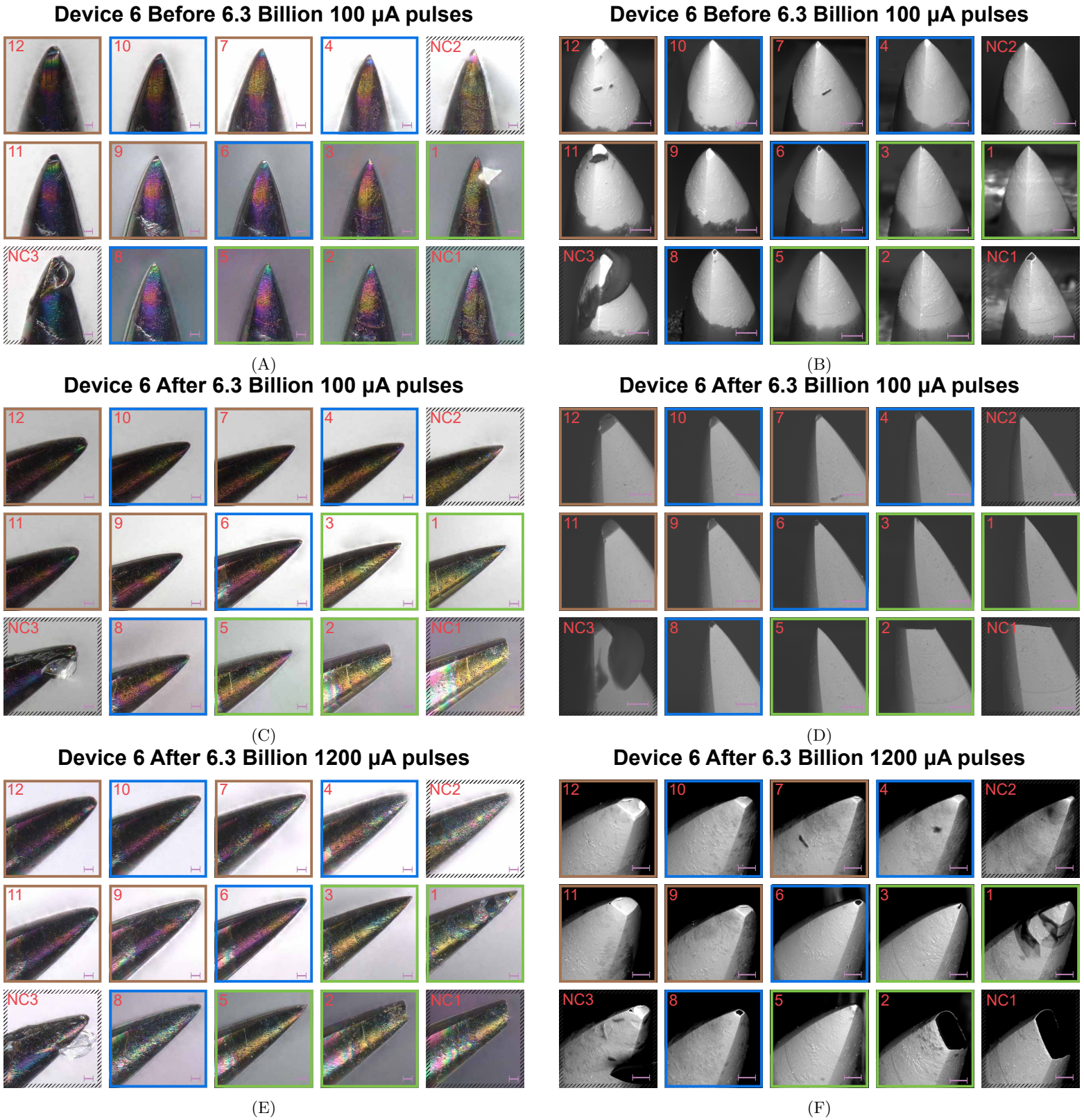


Figure S10: Device 6 Before and after Optical and Back Scattered Scanning Electron Microscopy 500× magnification images of all 15 electrodes in the same orientation as Figure 1. **(A)** Optical before TAA. **(B)** BSEM before TAA. **(C)** Optical after 100 μA stimulation. **(D)** BSEM after 100 μA stimulation. **(E)** Optical after 1,200 μA stimulation. **(F)** BSEM after 1,200 μA stimulation. All scale bars are 10 μm

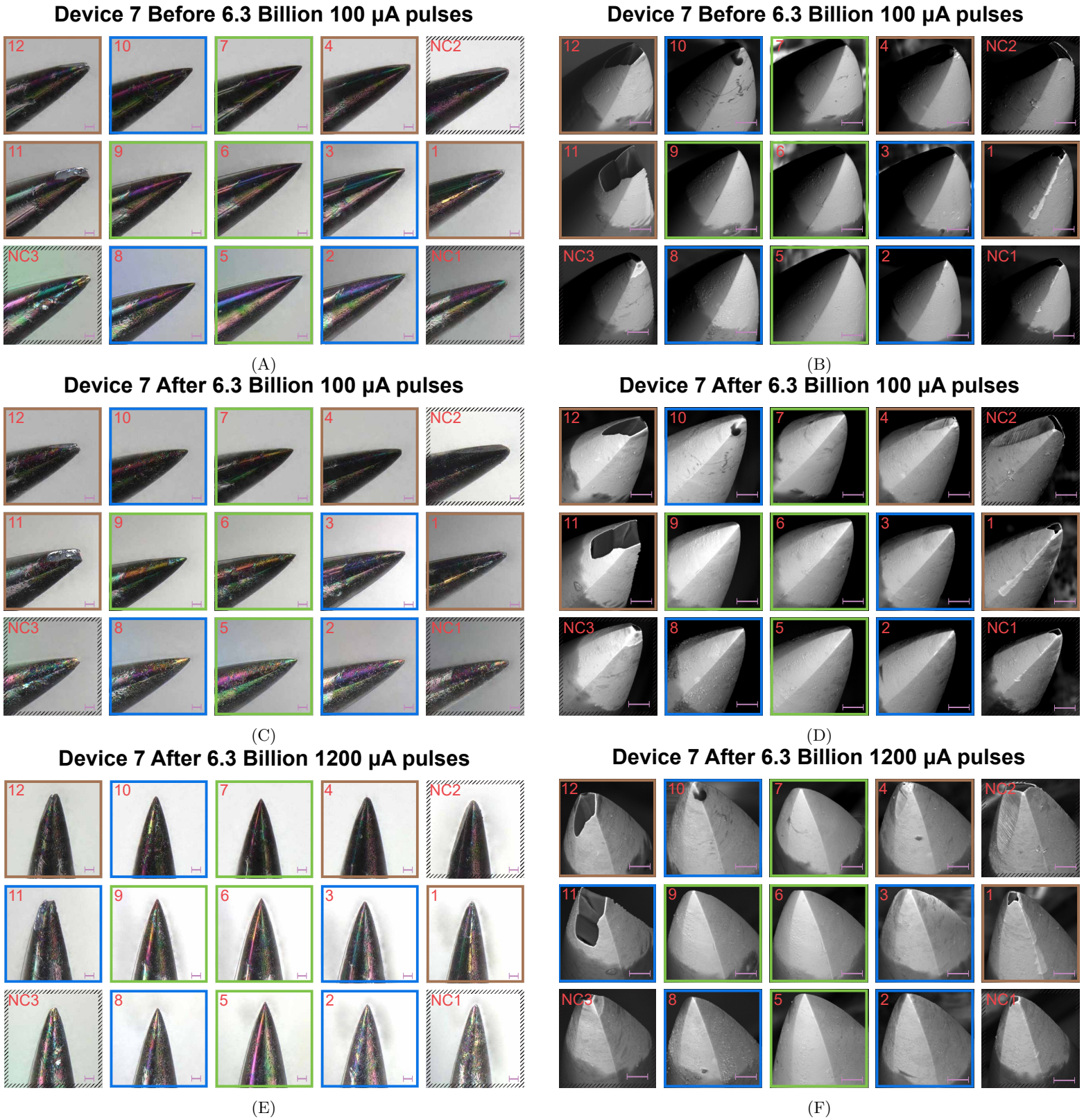


Figure S11: Device 7 Before and after Optical and Back Scattered Scanning Electron Microscopy 500× magnification images of all 15 electrodes in the same orientation as Figure 1. **(A)** Optical before TAA. **(B)** BSEM before TAA. **(C)** Optical after 100 μA stimulation. **(D)** BSEM after 100 μA stimulation. **(E)** Optical after 1,200 μA stimulation. **(F)** BSEM after 1,200 μA stimulation. All scale bars are 10 μm

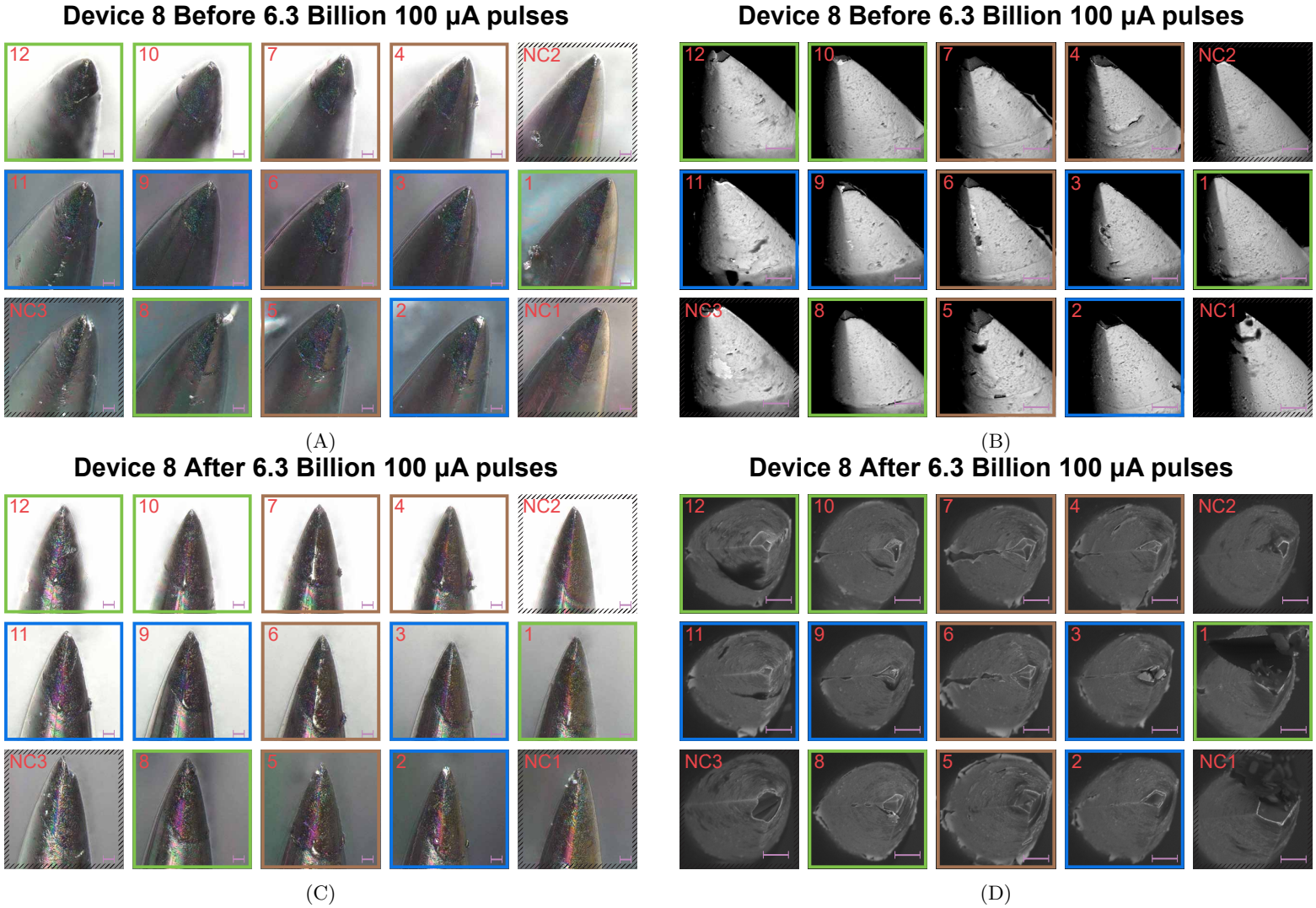


Figure S12: Device 8 Before and after Optical and Back Scattered Scanning Electron Microscopy 500× magnification images of all 15 electrodes in the same orientation as Figure 1. **(A)** Optical before TAA. **(B)** BSEM before TAA. **(C)** Optical after 100 μA stimulation. **(D)** BSEM after 100 μA stimulation. All scale bars are 10 μm

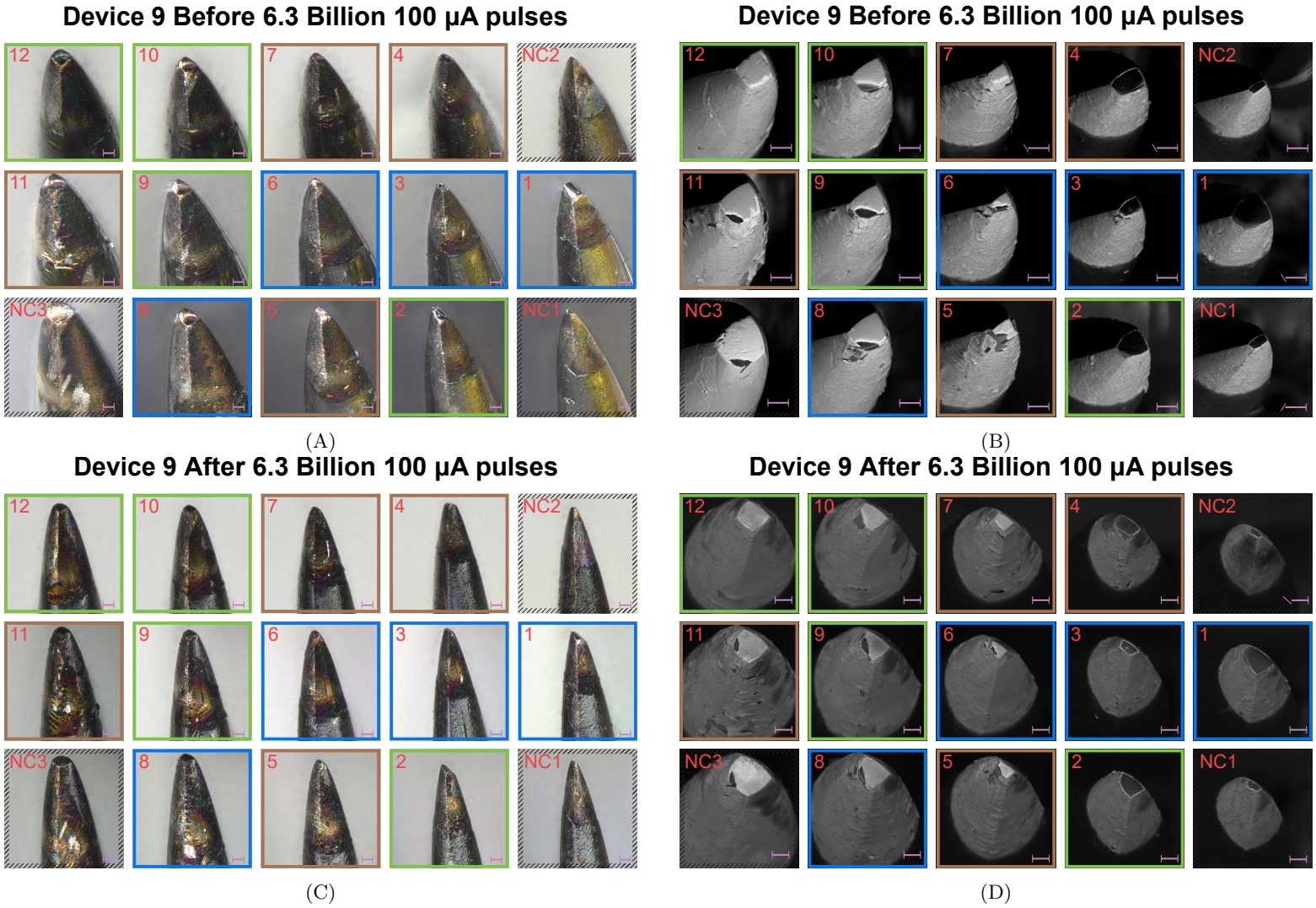


Figure S13: Device 9 Before and after Optical and Back Scattered Scanning Electron Microscopy 500× magnification images of all 15 electrodes in the same orientation as Figure 1. **(A)** Optical before TAA. **(B)** BSEM before TAA. **(C)** Optical after 100 μA stimulation. **(D)** BSEM after 100 μA stimulation. All scale bars are 10 μm