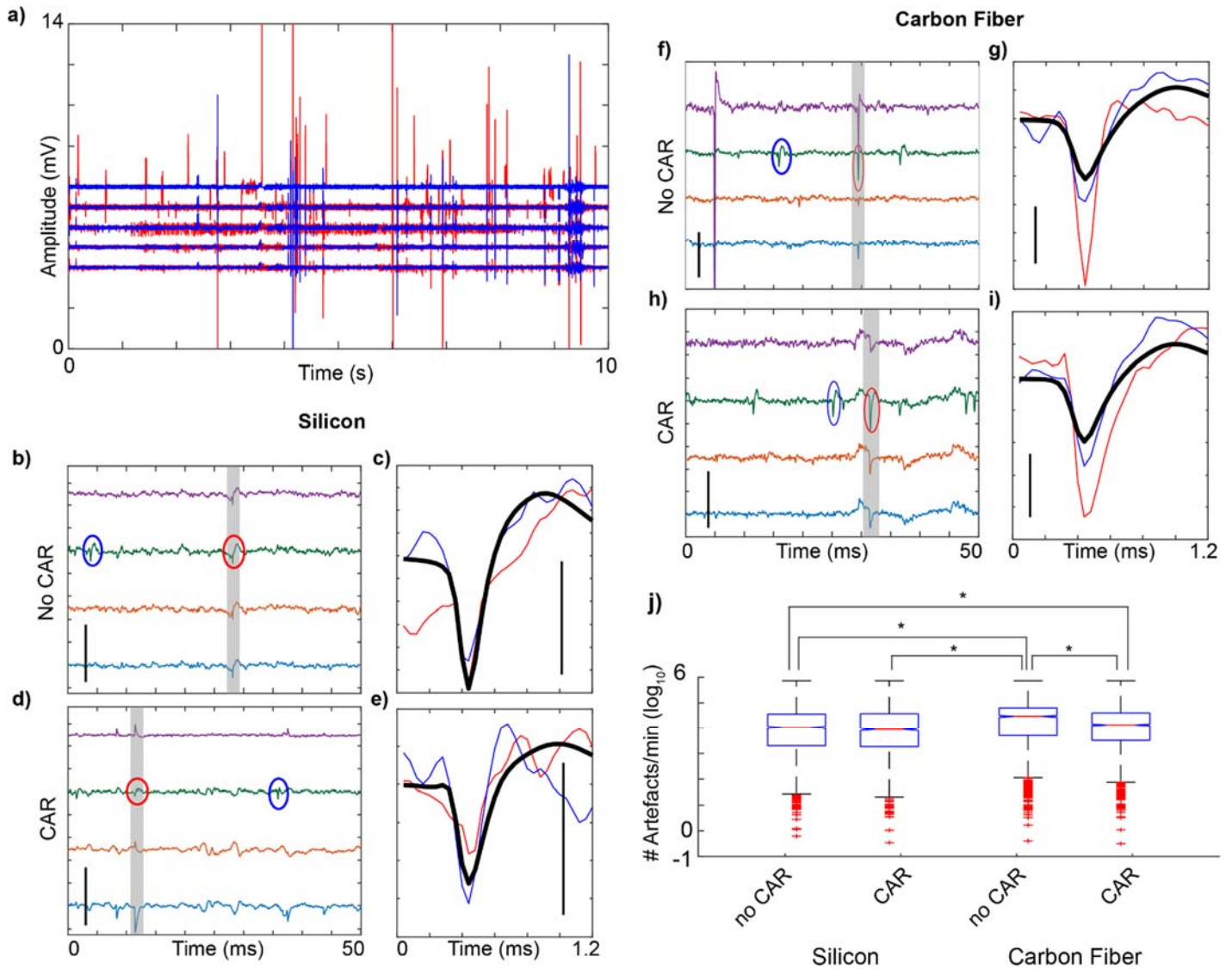
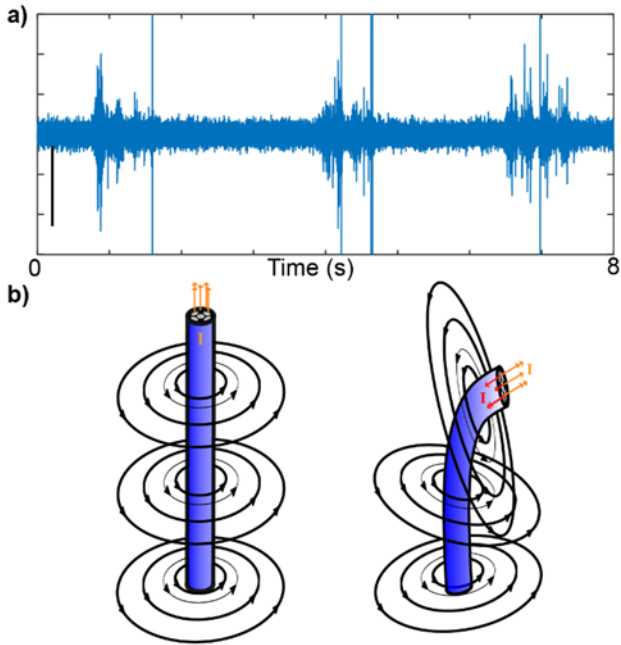


Supplemental Figure 1: Common average referencing does not completely eliminate motion artifact. a-c) Example 200 ms of data taken from an awake, freely moving Sprague-Dawley rat, implanted with a 16 channel

silicon array in M1, with varying degrees of processing. Application of a high frequency band pass filter (2nd order Butterworth filter, passband 0.3-1kHz) can cause artifacts (a) to resemble action potentials (b). Grey shading highlights artifacts detected using the algorithm defined in the methods. **d,e**) Circled artifacts and action potentials from a-b, shown before and after filtering (dashed and solid lines, respectively). **f,g**) Mean waveforms for clustered artifacts (d) and action potentials (e) from each channel without CAR (dashed line) and with CAR (solid line). CAR can reduce the amplitude of artifacts, to a scale more consistent with action potentials. **h**) Estimated rate of artifact incidence occur per minute, taken from a 600 second recording epoch (n = 2 rats, p < 0.001). Scalebar: a-c) 500 μ V



Supplemental Figure 2: Artifacts contaminate electrophysiology in carbon fiber and silicon arrays, with and without CAR. **a)** Sample recording data taken simultaneously from a carbon fiber array (red) and silicon array (blue), implanted in the right and left primary motor cortex, respectively, in an awake, freely moving, adult Sprague-Dawley rat (600s total recording duration). **b,d)** Action potentials and artifacts are clustered together from PCA in carbon fiber arrays and silicon arrays, without CAR. **c,e)** Circled waveforms from b and d, with mean waveform for that cluster shown in black. **f-i)** Same as b-e, except with CAR. **j)** Estimated rate of artifacts per minute for simultaneous recordings from carbon fiber and silicon arrays in one rat. (*) indicates $p < 0.001$. Scalebars b,d,f,h = 0.5mV, c,d,g,i = 100 μ V.



Supplemental Figure 3: Artifacts can be generated by movement. **a)** Brief recordings from a single channel microwire in a three electrode electrochemical cell (1x PBS, AgCl Reference, Pt Counter Electrode; not implanted in an animal). Recordings were conducted in a fully electrically isolated faraday cage as described in section 3.2. Microwire electrodes fully inside the faradaic cage were moved three times with a non-conductive zip tie held outside of the faradaic cage, generating high amplitude artifacts. **b)** Possible source of artifact generation. Movement of current carrying components generates electromagnetic motion artifact. Scalebar: 100 μ V.