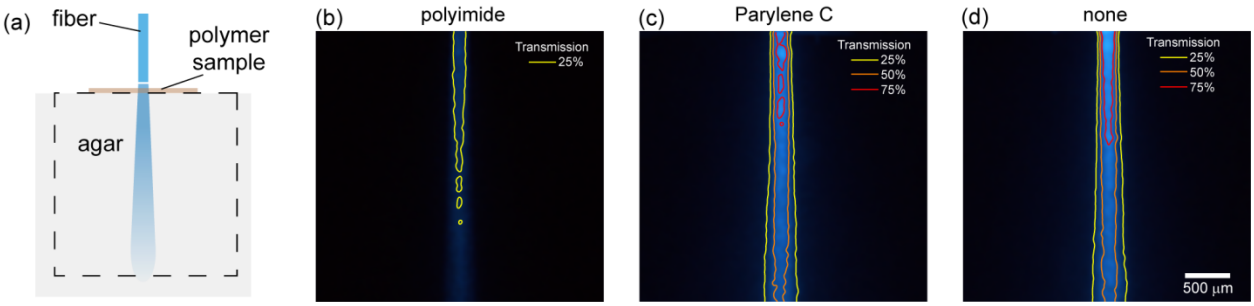
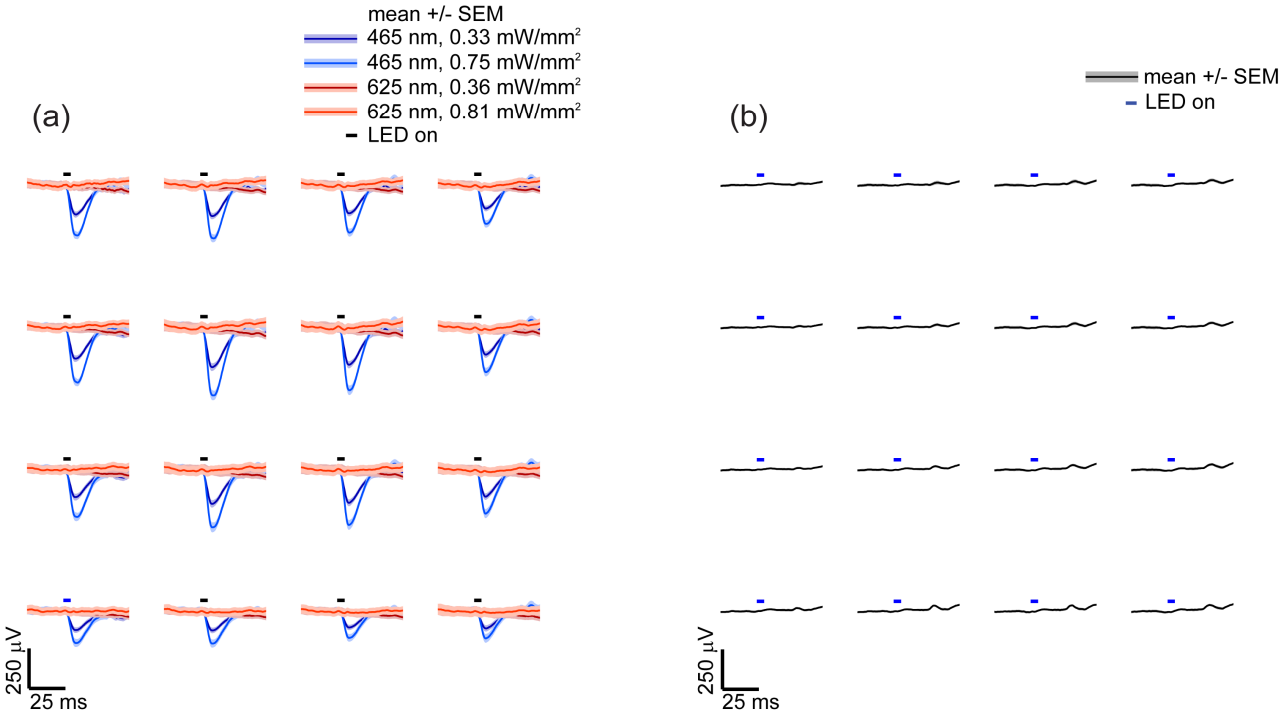
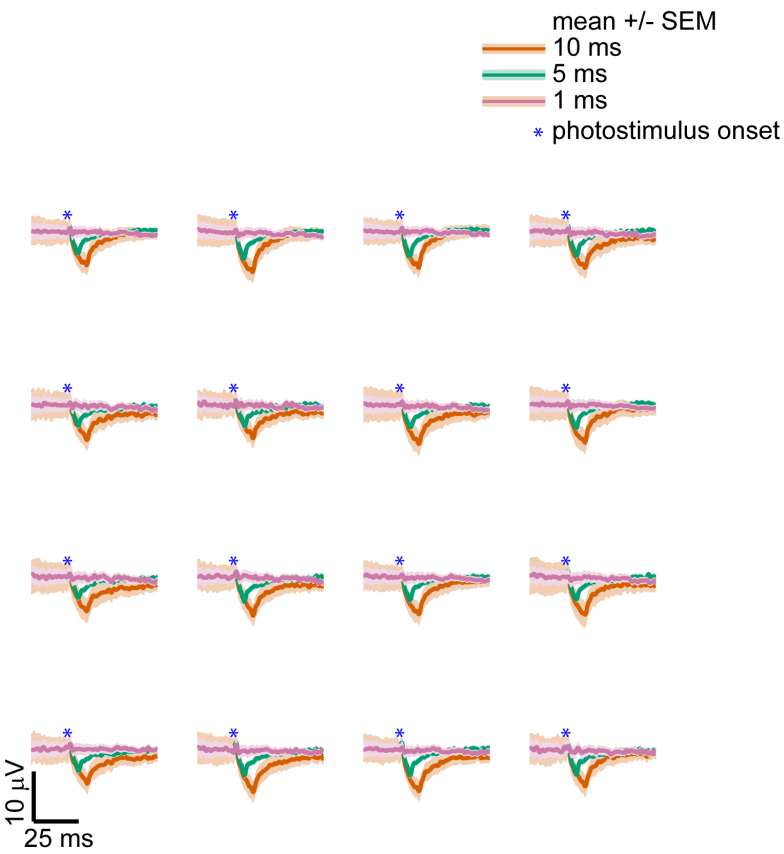
Supplementary figures



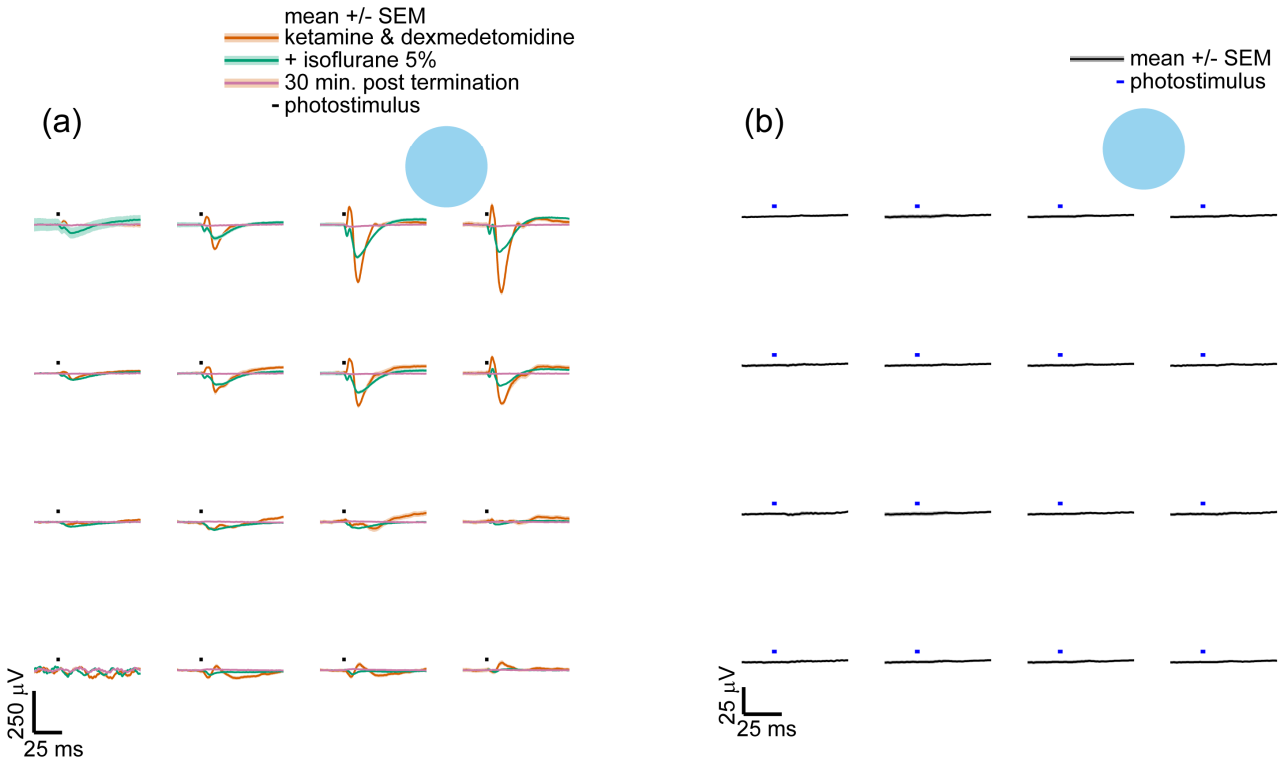
Supplementary figure 1. Comparison of light transmission through different electrode substrate polymers. (a) A laser-coupled fiber (200 µm diameter, 0.22 NA, 473 nm) was aimed through 25 µm polymer samples into a 1 % agar gel, which served as an imaging phantom for the brain. The dotted square delineates the image region. Transmission through (b) polyimide was less than that through (c) Parylene C, which was more similar to (d) no sample at all. Relative isointensity lines are drawn for 25%, 50% and 75% of the maximum.



Supplementary figure 2. Controls for stimulus artifacts. (a) Pulses of blue light (465 nm, 3 ms) evoked negative potentials of several hundred microvolts, but red light (625 nm) did not. Brighter pulses of blue light (0.75 mW/mm^2) evoked larger negative potentials compared to less intense (0.33 mW/mm^2) stimuli. Red light (625 nm) evoked no response as expected. ChR2 is known not to respond at wavelengths longer than 550 nm. 50 trials were averaged for each condition. (b) Wild type mice lacking ChR2 showed no response to pulses of blue light (465 nm, 3 ms, 0.75 mW/mm^2). 50 trials were averaged.



Supplementary figure 3. Electrode in saline test for the Becquerel effect. An electrode was positioned in normal saline to replicate figure 2(c) as closely as possible. A blue LED (465 nm, RGB MC-E, Cree) wasvpositioned 20 mm. The LED was pulsed at maximum irradiance (0.75 mW/mm^2) for 1, 5 or 10 ms. The light-induced artifact was less than 10 microvolts, much smaller than the optogenetic signal observed *in vivo* (see figure 2). The small size of the artifact can be attributed to the low optical power used, the relatively low electrode impedance (~50 kΩ @ 1 kHz as compared 1 MΩ for most intracortical electrodes), and the orientation of the electrode relative to the light source. The light hit the Parylene C insulated backside of the electrode sites and traces. 465 nm photons have an energy less than the work function for the metals used in the array, so the photoelectric effect was minimal.



Supplementary figure 4. Control experiments for the Becquerel effect with fiber-coupled laser photostimulation and micro-ECoG recordings. (a) The optogenetically evoked wave form depended on the anesthetics. Under ketamine and dexmedetomidine, as in figure 7, a large waveform is observed in response to photostimulation (3 ms, 78 mW/mm^2, 473 nm) 0.45 mm below the cortical surface in region indicated. The addition of 5% isoflurane changed the shape of the waveform and generally decreased the amplitude of the signal. 30 minutes following the end of this terminal procedure, the signal was flat, with no observable light-induced artifact. 50 trials were applied for each condition. (b) Replicating the experimental setup in a dish of saline, no light-induced artifact was observed with similar stimulus conditions (3 ms, 78 mW/mm^2, 473 nm, 0.45 mm below array). 372 trials were applied for (b). The lack of a measurable artifact with the laser-coupled fiber setup can be attributed the orientation of the optical fiber relative to the array. The 0.22 NA fiber below the electrode and pointed downward into the tissue, away from the array, so only scattered light could possibly reach the array.