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Controlling growth and electrical connectivity of neuronal cells patterned on surfaces ROSS BEIGHLEY, ELISE SPEDDEN, Physics and Astronomy, Tufts University, JAMES WHITE, Physics and Astronomy and Biomedical Engineering, Tufts University, CRISTIAN STAII, Physics and Astronomy, Tufts University — In the developing brain biochemical and geometrical cues are an essential source of information used by neurons when wiring up the nervous system. However, our current understanding of the mechanisms by which various guidance factors control the path that growing axons/dendrites follow to reach their targets and form functional electrical connections remains qualitative. A current limitation for the study of neural network formation is the ability to precisely control the growth and interconnectivity of small numbers of neurons. Here we present a combined Atomic Force Microscopy - Fluorescence Spectroscopy approach for patterning neurons on 2-dimensional substrates and precisely controlling their location, growth and interconnectivity. We demonstrate that this approach allows one to: a) form simple neuronal circuits in well-controlled geometries; b) guide the formation of functional synapses between neurons, and c) measure the electrical activity of small groups of neurons. We also discuss the implications of these results for our current understanding of the fundamental mechanisms that govern the development of electrical connections between neurons.

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