Retinal prostheses aim to restore functional vision to those blinded by outer retinal diseases using electric stimulation of surviving neurons. Previous work indicates that repetitive stimulation with stimuli that activate the synaptic network reduces the sensitivity of retinal neurons to further stimulation. Such desensitization may contribute to the fading of visual percepts over time reported by human subjects. Here, we show that desensitization may be more complex than previously considered. We recorded spike trains from rabbit retinal ganglion cells and found that desensitization persists in the presence of inhibitory blockers (strychnine and picrotoxin), indicating amacrine cell inhibition is not solely responsible for reducing sensitivity in response to electric stimulation. The threshold for direct activation of the ganglion cell changes little during the simultaneous desensitization of the synaptically mediated response, indicating that desensitization likely occurs upstream of the spike generator. In addition to rapid desensitization acting over hundreds of milliseconds ($\tau = 176.4 \pm 8.8$ ms), we report the presence of slow acting desensitization with a time course of seconds ($\tau = 14.0 \pm 1.1$ s). The time courses of the two components of desensitization that we found are similar to the two phases of brightness fading seen in human subjects. This suggests that the reduction in ganglion cell firing due to desensitization may be responsible for the fading of visual percepts over time in response to prosthetic stimulation.