Popular science summary

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The animal brain is a fascinating organ which helps us to organize and interpret all of the impressions that we constantly receive from the world. It is also the brain that serves as the body’s control center where every major decision such as thoughts, body movement and breathing is governed. The brain consists of special types of cells called neurons, where neurons communicates with each other constantly through electrical signals.

The brain can be likened with a complex road infrastructures with highways and smaller roads. This infrastructure needs to be controlled as to not cause severe traffic accidents, which is done with traffic lights. But what if all the controlling traffic lights stopped working? The infrastructure would quickly crumble as cars would smash into each other. The same goes for the brain. If the ability to control the vast amount of electrical signals we receive through the neurons disappears, the brain would be overloaded and the individual will experience horrible seizures. This is the case for many people around the globe today, and around 70000 individuals in Sweden alone suffers from this impairment, which is otherwise known as epilepsy.

Epilepsy is a serious brain illness that is still to this day not fully understood; where does it come from and how can one cure it? There exists treatment options that mostly involve the use of medication, but these only alleviate the symptoms. A more radical approach involves surgery; the affected brain region is removed. This alternative leaves the patient with a defect brain that cannot interpret the world the same way it did prior to the surgery.

There exists other promising alternatives though. Optogenetics is a new technique that is being investigated as a way to study and potentially treat epilepsy. With this technique it is possible to modify neurons so that they become sensitive to light, so that they can be turned on or off if light is shun upon them. Going back to the infrastructure analogy; this technique can be likened with placing more efficient, robust and controllable traffic lights on the roads to stop future traffic accidents.

For this technique to work it requires new light sources about the same size as neurons that can stimulate individual nerve cells. It involves creating miniaturized light-emitting devices, or LEDs, which can be integrated with human tissue. At Lund University a new approach for making these light-emitting diodes have been developed, where the devices look like small bumps (or “micro-platelets”) on a otherwise flat surface.

This thesis focuses on making these devices compatible to use in a research environment. The intent of these devices is to study the how neurons behave as a group when stimulated with light. It thus requires that the device can house living neurons on top its surface, so that the neurons are in close contact with the light-emitting platelets.

The goal of the thesis can be formulated into two main objectives. First, a platform would need to be designed and tested. This platform will house the device, complete with electrical contacts, and at the same time protect it from potential hazards in the lab environment. Secondly, the device has to be surface treated i to support neuron growth when applying cells on top of the device.

If these objectives are somewhat completed, then neuroscience is one step closer in understanding how the brain works at a deeper level. This understanding can lead to better treatments for people suffering from the dire effects of epilepsy.