LED-based Cochlear implants - Novel hearing solution

Optogenetics is a rapidly growing subject in the neurosciences field that uses light-emitting diodes (LED) to depolarise nerve cells. This new technology opens up a promising new tool in cochlear implants.

Within the framework of the BMBF-funded research project "Optical CI" (Funding code 13N13730), a novel method of neurostimulation by LED light was investigated in the form of an optogenetic cochlear implant. For the last three and a half years inomed Medizintechnik GmbH lead a consortium, which includes the Institute for Microsystems Technology (IMTEK) at the University of Freiburg, and the Institute for Auditory Neurosciences at the University of Göttingen, working on the development of a cochlear implant with micro-LED light technology. A cooperative company MED-EL from Innsbruck, Austria, was also involved in the research project. This research project was successfully completed in December 2018.

Optogenetic stimulation of the auditory nerve – an alternative to conventional implants

Conventional cochlear implants are based on electrical stimulation which have a limited frequency resolution. Sound can therefore be distorted to the patients, making it difficult to communicate in situations where there is background noise. Optogenetic cochlear implants with targeted, spatially precise neurostimulation by light to achieve a better frequency resolution could be a pioneering alternative.

Optogenetic cochlear implants developed and tested

Micro-LEDs can reach depolarisation neuronal cells in the cochlea in a more targeted manner which results in a higher frequency hearing resolution. This enables the patients to improve their hearing experience. In the Optical CI project, highly efficient thin-film LEDs in the dimension of 0.06 x 0.06 mm² were integrated onto a flexible polymer carrier and the feasibility of the novel stimulation technique with this optical implant was demonstrated in other models.

Further research using this novel technology is needed in order to achieve the most natural hearing experience for patients with hearing impairments. Further to this, the start-up project 'OptoGenTech' was founded in Göttingen early in 2019 with the aim to advance developments in optical cochlear implants.

Cochlear implants
Cochlear implants are artificial hearing aids that replace the function of the damaged inner ear (cochlea) and can restore hearing to people with severe hearing loss. Audio signals are converted into electrical signals and transmitted to the auditory nerve via electrical stimulation in the cochlea. These signals are transmitted via the auditory nerve and auditory pathway to the brain, where auditory perception takes place.

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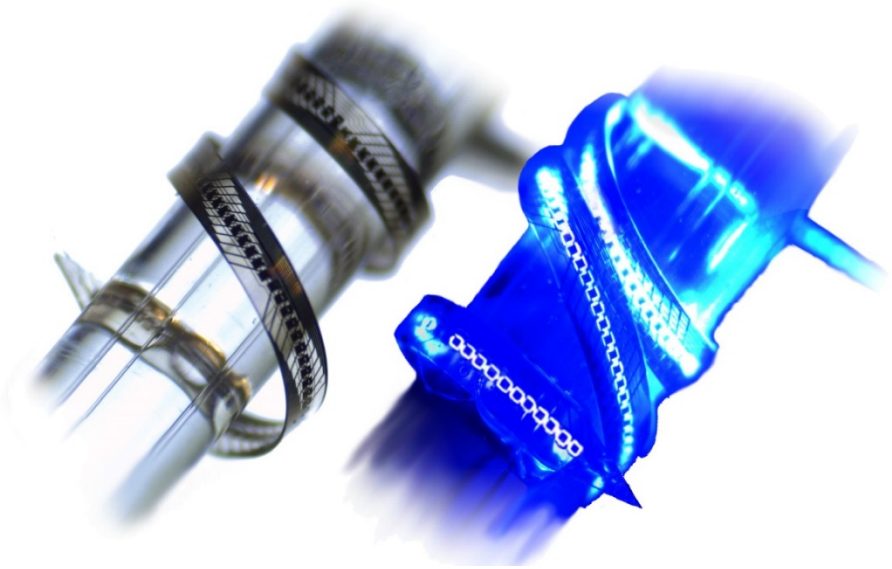

Highly flexible array of 144 LEDs (0.06 mm x 0.06 mm) wrapped around a glass rod (diameter 1 mm); left when switched off, right when operating all LEDs.

Source: Institut für Mikrosystemtechnik, Albert-Ludwigs-Universität Freiburg

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