Implantable Neural Interface for Cochlear Implants

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Use of LPKF laser technology ushers in new era in the medical implant industry

A cochlear implant is a surgically implanted, electronic medical device that provides the sense of sound to people with hearing loss. In use for a few decades now, the device has enabled or restored hearing for 700,000 people. However, there are more than 460 million people with hearing loss worldwide. More than 60,000 cochlear implants are sold annually, but at least 60,000 babies are born with hearing loss in India and China alone. A single unit costs about $20,000 to $25,000 because the microelectrode array inserted into the cochlea is manufactured and implanted manually.

TODOC, a South Korean startup, was founded to address this global shortage of cochlear implants by developing manufacturable cochlear electrode arrays using an ultrashort-pulse laser system, the LPKF ProtoLaser R.

The conventional cochlear electrode array consists of 16 to 22 platinum alloy-based electrode contacts and wires encapsulated in medical-grade silicone. The maximum dimensions are from 0.4 mm to 0.8 mm in diameter and 20 mm in length. A new cutting-edge standard was set 20 years ago with the aforementioned number of electrodes and wires.

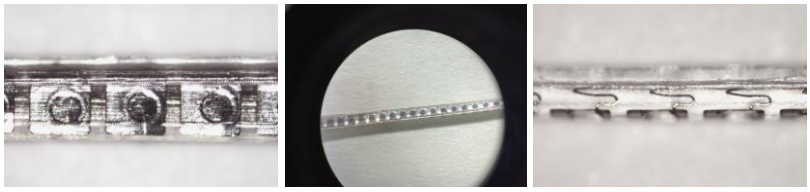
Since then, many attempts have been made to fabricate the cochlear electrode array using a semiconductor fabrication process. Unfortunately, the base material and the process that are suitable for the semiconductor process are not biocompatible.

Founded in 2015, TODOC started to use the LPKF ProtoLaser U3 in 2016 and LPKF's short-pulse laser system ProtoLaser R in 2018 to fabricate microstructures on platinum alloy foil. With the help of these laser systems, TODOC has now succeeded in accommodating 32 channels on these biocompatible alloys and automating production to the greatest possible extent. In this way, all 32 can be produced in a single pass. To

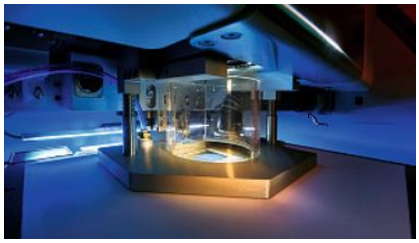
do this, Kyou Sik Min, CEO and founder of TODOC, and his colleagues patterned lines 16 µm in width spaced 32 µm apart on platinum foil and integrated 32-channel contacts and wires in a single process – rather than manually fabricating 22-channel electrodes. The final electrode array is achieved after several steps of encapsulating the contacts and wires. With this production process, TODOC manufactured the first commercially viable cochlear electrode array in history.

After launching their first 32-channel cochlear implant system in the South Korean market in 2021, TODOC plans to expand the sales network globally. The company aims to make cochlear implant surgery available in developing countries for people with hearing loss who cannot benefit from cochlear implants due to the imbalance between supply and demand in the current market environment. The goal is that people on all continents can be helped to hear again without having to worry about the costs.

A scientific report on this topic entitled “Manufacturable 32-Channel Cochlear Electrode Array and Preliminary Assessment of Its Feasibility for Clinical Use” can be found under the heading “Related publications” at https://www.lpkf.com/en/industries-technologies/research-in-house-pcb-prototyping/medical-research.



Figs. 1a, 1b, and 1c (alternative): 32-channel cochlear electrode arrays manufactured using the LPKF ProtoLaser R



Figs. 2a and 2b (alternative): The LPKF ProtoLaser systems are the benchmark for PCB processing. They work precisely and fast and are easy to use thanks to sophisticated software. The laser systems are compact and undemanding. They only require a power outlet and compressed air and fit through any lab door. The laser structuring process is also predestined for manufacturing for RF and microwave applications, flexible electronics, and glass.

About LPKF

LPKF Laser & Electronics AG is a leading provider of laser-based solutions for the technology industry. Laser systems from LPKF are of central importance for the manufacturing of printed circuit boards, microchips, automotive parts, solar modules, and many other components. Founded in 1976, the company has its headquarters in Garbsen near Hanover and operates worldwide through subsidiaries and agencies. Around 20 percent of the workforce is engaged in research and development.