KOALA

Precision Laser Technology for Controlled Nerve Stimulation and Microablation

Selectively stimulating individual nerve fibres and, where required, ablating them could offer new possibilities for treating spasticity. The KOALA collaborative research project is investigating a laser-based approach intended to reach nerve fibres located deeper within a nerve. By combining optical stimulation with neurophysiological feedback, the project aims to establish a precisely controlled procedure. Sacher Lasertechnik is developing a tunable laser source with dynamic focusing and investigating the spatial distribution of heat deposited in nerve tissue.

Project at a glance

- **Collaborative project:** Controlled Stimulation and Microablation of Nerves Using Lasers
- **Acronym:** KOALA
- **Consortium coordinator:** inomed Medizintechnik GmbH
- **Project partners:** inomed Medizintechnik, Sacher Lasertechnik, University Medical Center Freiburg and Fraunhofer Institute for Microengineering and Microsystems IMM
- **Sacher Lasertechnik subproject:** Dynamically Focusable Laser for Controlled Nerve Stimulation and Microablation
- **Funding reference:** 13N17779
- **Funding initiative:** Photonic and Quantum-Based Technologies for Medical Diagnostics and Therapy

Objectives and Approach

KOALA aims to enable more selective treatment of individual nerve fibres within a nerve. One potential application is selective dorsal rhizotomy for treating spasticity. The project investigates how laser light can be used for functional identification and subsequent targeted microablation of nerve fibres.

Light scattering in nerve tissue presents a central challenge. It makes it difficult to confine optical and thermal effects to a small region deep within the tissue. The consortium therefore combines simulations of light propagation, experimental investigations and new focusing concepts. It is also investigating whether temporary treatment of the tissue with suitable dyes can reduce scattering and increase penetration depth.

Sacher Lasertechnik's Contribution

Sacher Lasertechnik is developing a customised laser tool with adjustable wavelength, power, pulse duration and focal position. The planned system will provide wavelength tuning from 1010 to 1085 nanometres, peak powers exceeding three watts and variable pulse durations ranging from nanoseconds to milliseconds.

A dynamic focusing unit is intended to position the region of laser interaction precisely in three dimensions. The objective is to confine heat deposition to individual nerve fibres while minimising thermal exposure of surrounding tissue.

To support this work, Sacher Lasertechnik is establishing a thermal measurement setup incorporating temperature probes and thermal imaging microscopy. Light propagation, absorption and heat

distribution will be investigated first in nerve phantoms and subsequently in excised nerve tissue. Measurements will be compared with simulations by Fraunhofer IMM and used to optimise the irradiation optics. The developed laser tool will be provided to University Medical Center Freiburg for further preclinical evaluation.

Expected Results and Outlook

The consortium aims to develop a technology demonstrator combining optical nerve stimulation and microablation with synchronised neurophysiological measurements. Its function will be investigated preclinically, including in a large-animal model. This work will identify and distinguish suitable operating ranges for stimulation and ablation.

KOALA thus establishes a foundation for more precise, optically controlled treatment of nerve fibres in the future. Beyond the medical application, insights into tunable laser sources, beam shaping and focusing are also intended to support the further development of laser systems for Raman spectroscopy.