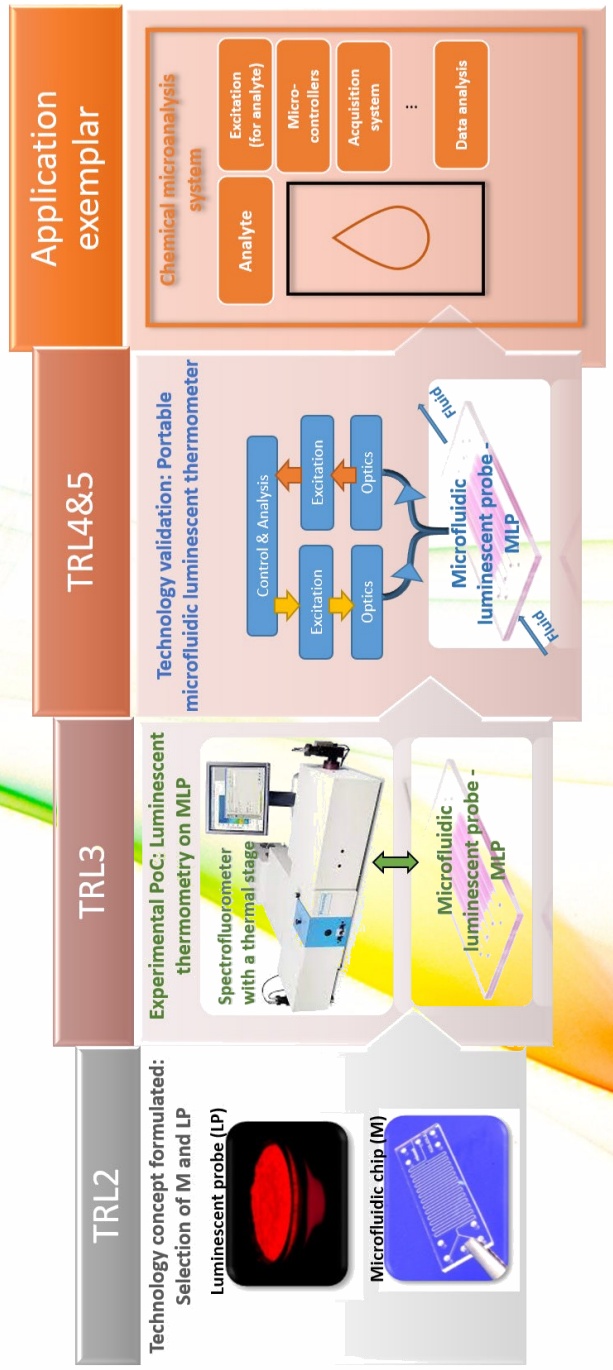
PROJECT FLOW



TECHNOLOGY FOR REMOTE TEMPERATURE MEASUREMENTS IN MICROFLUIDIC DEVICES

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Program PRISMA

PROJECT

- Develop an optical self-referencing thermometer with a spatial resolution of less than 1 μm by the targeted development of luminescence thermometry.
- Design and fabricate novel luminescence thermometry probes using cutting-edge inorganic luminescent materials that emit in the red–deep red–NIR spectral regions and are highly temperature sensitive.
- Establish a completely new technology for remote measuring and controlling temperature in microfluidic devices at the technology readiness level 5 (TRL5), by advancing temperature readings from luminescence.
- Fabricate a showcase exemplar of a photothermally based highly sensitive microfluidic chemical analysis system for the quantification of analytes and the detection of individual nanoparticles in a liquid flow as a proof of the science-to-technology breakthrough.
- Show the prolonged applicability of REMTES outcomes beyond this project in the environmental, biomedical, and optofluidic fields. Spin-offs, small and medium enterprises involved in developing specialty microfluidic devices, will benefit from this research in the mid-term. In the long term, advancements in microfluidics and microbiochemical analysis methods will impact both healthcare and the environment.

Objective 1

Self-referencing luminescence thermal probes and microfluidic chips

Design and synthesis of chemically and thermally stable inorganic submicron- and nano-sized transition metal and rare earth-doped wide band-gap luminescent thermal probes. Design and fabrication of microfluidic chip for both in situ point and 2D mapping temperature measurements.

Objective 2

Theoretical and computational modeling

Theoretical and computational modeling of luminescence properties of thermal probes, heat-producing/diffusion mechanisms, and photothermal conversion efficiency will be performed to tailor the properties of the probes of interest, guide the design and optimization of microfluidic chips, and design of microfluidic luminescent thermometer (luminescence probe integrated into the microfluidic chip) for the Proof of Concept (PoC) study.

Objective 3

Microfluidic luminescence thermometers for point and 2D mapping temperature measurements

A microfluidic luminescent probe (MLP) consisting of a luminescence probe integrated into the microfluidic chip will be designed, fabricated, and tested. Both point and 2D mapping temperature measurements will be performed using luminescent thermometry and commercially available laboratory spectrofluorometer.

Objective 4

Technology validation

To show the technological applicability of the approach two validations are foreseen:

1. A portable microfluidic luminescent thermometer composed of appropriate optical/electronic components and MLP will be developed and validated for both point and 2D temperature measurements.
2. A portable microfluidic luminescent thermometer will be upgraded with a central fluidic system for point and 2D in-situ temperature measurements of selected analyte fluid flowing in microchannels

To demonstrate the transferability of this technology and its wider applicability an application exemplar - the photothermally based highly sensitive microfluidic chemical microanalysis system for the quantification of analytes and the detection of individual nanoparticles in a liquid flow will be presented.

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