Fachbereich 04
Produktionstechnik

Fachgebiet 08
Messtechnik, Automatisierung und Qualitätswissenschaft

BIMAQ

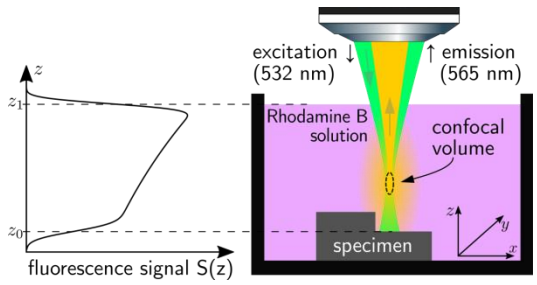
Bachelor's/ Master's Thesis

Spatially resolved temperature measurement in fluids using confocal fluorescence microscopy

Laser chemical manufacturing (LCM) offers the potential to manufacture complex microstructures on metals without contact, where the material removal is based on a localized chemical reaction with an electrolyte fluid. Suitable process parameters are currently being researched to establish the LCM-process on an industrial scale. It is known that the achieved surface quality depends mainly on the laser-induced surface temperature. The control of the LCM process thus requires an in-situ measurement method that simultaneously records process parameters such as material removal rate and temperature.

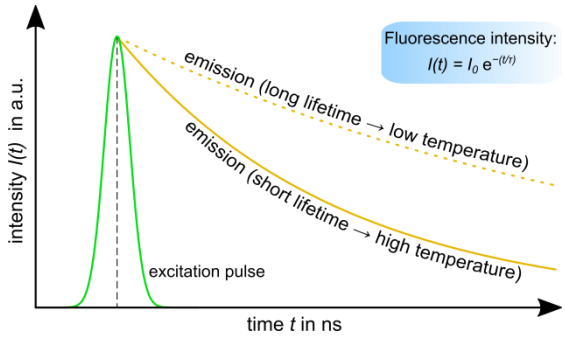
In preliminary work of our institute, an in-situ measurement of the surface geometry within liquids could already be realized by means of confocal fluorescence microscopy (see Fig. 1). The geometry measurement is now to be extended to include the measurement of the process-relevant fluid temperature. Based on the determination of the fluorescence lifetime, which depends on the temperature of the fluorophore, the temperature distribution shall be determined spatially resolved during the geometry measurement.

1)



1) Principle of geometry measurement: The vertical movement of the laser focus generates a signal change at the boundary layer to the measuring surface which is detected by the con-focal microscope.

2)



2) Fluorescence decay with pulsed excitation: The fluorophore is excited with a short light pulse, the emitted fluorescence is measured time-resolved and the lifetime τ is determined. The temperature of the fluorophore depends directly on τ.

Potential contents of the thesis can be:

- Planning and realization of planar fluorescence lifetime measurements
- Development of measurement and evaluation strategies for the combination of fluorescence lifetime-based temperature measurement with existing geometry measurement
- Estimation of the measurement uncertainty

Your profile:

- Interest in optical metrology
- Enjoyment of experimental work
- Programming skills (e.g. Python) for measurement evaluation is an advantage

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