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Microstructured optical fibre as biosensor for pathogen detection on DNA-level

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Introduction

Metal nanoparticles have a great potential in a wide range of (bio) analytical applications. In dependency of their shape, size and material their optical response vary from UV up to NIR range. They are implemented in biochip technologies, biosensors, molecular plasmonics and in biophotonics. Microstructured optical fibres serve as innovative optical devices when prepared with well-defined plasmonic layers of metal nanoparticles with different possibilities for their readout.

Methods

A suspended core fibre with three holes containing metal nanoparticles as plasmonic structures on the internal capillary wall was investigated. Implementation of self-assembling monolayer techniques enables plasmonic structures with an even distribution of metal nanoparticles inside the fibre. These micro structured optical fibres can be used as sensors for surface enhanced Raman spectroscopy sensing by applying biomolecules inside the fibre.

Results

One of the goals is the employment of the surface enhanced Raman spectroscopy technique for analytical devices combined with the microstructured optical fibres. Investigating the nanoparticle modified fibre as surface enhanced Raman spectroscopy sensor, crystal violet as analyte was applied in a first experiment. The fibre without nanoparticle shows a weak crystal violet spectrum while the fibre filled with nanoparticle creates a strong crystal violet spectrum. Further, a DNA hybridization detection scheme was performed inside the fibre using Cy3-labeled target DNA. Here, the detected spectrum is dominated by the contribution of the Cy3-label.

Conclusion

Within this contribution, a suspended core fibre with three holes containing metal nanoparticles as plasmonic structures on the internal capillary wall is presented as innovative optical device allowing surface enhanced Raman spectroscopy readout. Implementation of self-assembling monolayer techniques enables plasmonic structures with a homogenous distribution of metal nanoparticles. These microstructured optical fibres can be used as sensors for DNA sensing as demonstrated.

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