Cluster decorated recognition elements on DNA origami for surface enhanced Raman spectroscopic detection methods

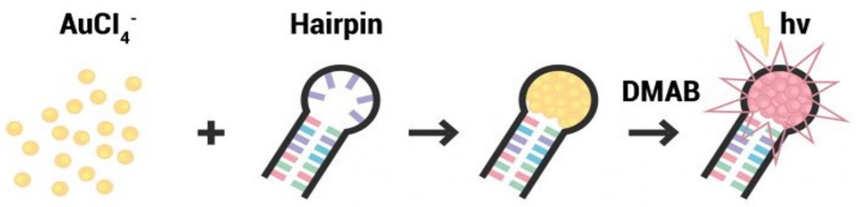
Saloni Agarwal, Renata F. Martins, Frank F. Bier (contact: saloni.agarwal@uni-potsdam.de)

How it works

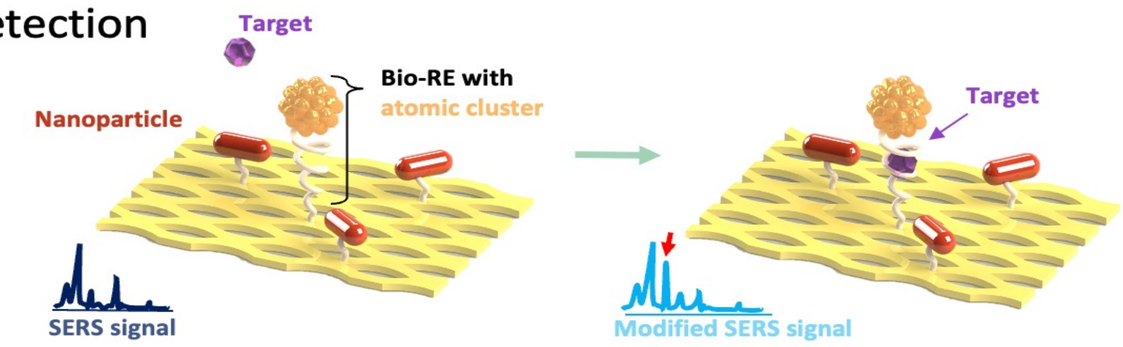
DeDNAed innovative bioanalytical platform

Composed of:

- **Biological sensor element with AC integrated:** Metallic atomic clusters (ACs) are integrated into a biological recognition element (DNA or antibody, bio-RE) improving fluorescence properties over normal plasmonic nanoparticles (NPs) due to their higher surface/volume ratio
- **DNA origami-based Nanoarray**: made of additional metallic NPs, precisely controlled by a DNA origami template and will lead to a signal enhancement. The DNA origami serves as an individually, inter- and intramolecularly programmable "nano-breadboard".
- **Surface-Enhanced Raman Spectroscopy** (SERS) detection



Schematic formation of fluorescent DNA-hosted Au-nanoclusters and the hairpin DNAs, single-stranded DNAs and fully matched DNAs.

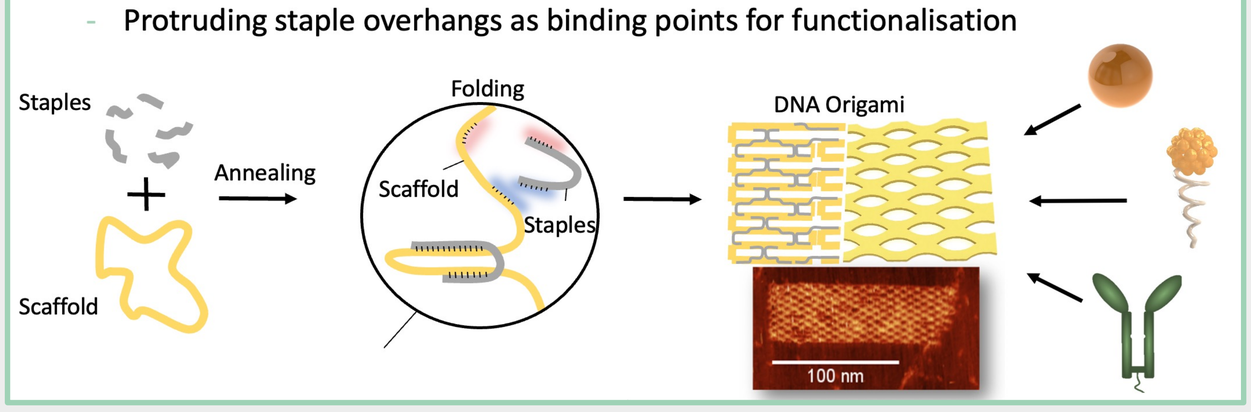


Schematic sketch of the change in the SERS signal upon binding of the analyte to the bio-RE (e.g. DNA aptamer).

DeDNAed – Background

What is DNA Origami?

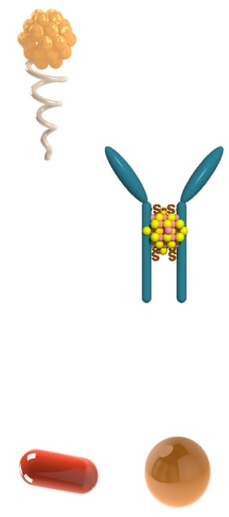
- **Nano-breadboard by DNA-driven self-assembly**
  - Controlling of scaffold folding (size and shape) by staple sequence
  - Protruding staple overhangs as binding points for functionalisation



DeDNAed – Project Overview

WP 2 – Design & Production of Sensing Element

- Design & synthesis of the sensing biorecognition elements (bioREs)
  - DNA aptamer → Aflatoxin
  - Peptide → Influenza
  - Antibody → Interleukin-6
  - DNA probes → SARS-CoV-II N-gene
- Integration of Atomic clusters (AC) in bioRE
- Providing different shaped metallic nanoparticles
  - For Raman signal enhancement



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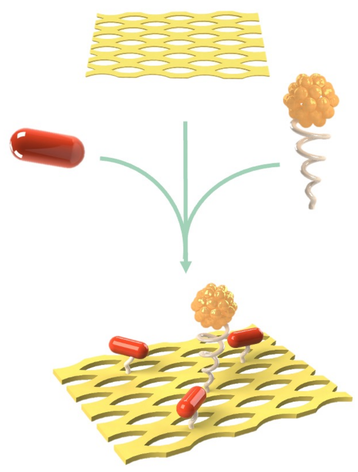
WP4 – Synthesis & Characterisation of DNA Origami Hybrid

- Assembly of all components of biosensor to DNA hybrid structure
  - Bio-RE
  - NP
  - DNA origami
- Structural and optical characterisation of the DNA origami hybrid
  - SERS signal
  - Binding strength / affinity



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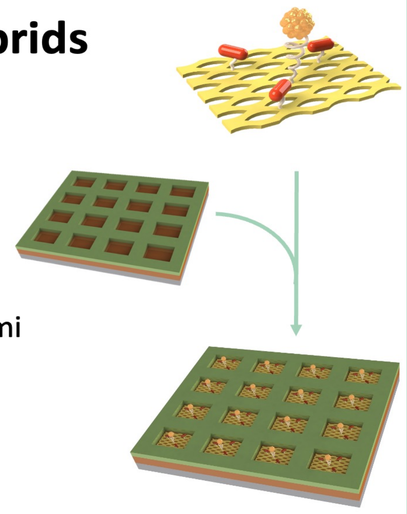
WP5 – Integration of DNA Origami Hybrids

- Providing of thin-film system for biosensor surface immobilisation
  - Chemical contrast for selectivity
  - Topography contrast for alignment
- Development of immobilisation procedure for DNA origami hybrid
  - High yield
  - Side-specific immobilisation
  - Single occupancy/accurate array alignment



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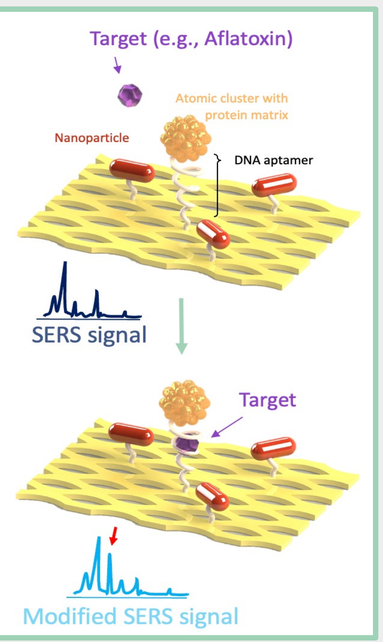
WP6 – Platform Validation

- Biosensor Assay development
- Characterisation of biosensor platform
- Validation against state of the art
  - High yield
  - Side-specific immobilisation
  - Single occupancy/accurate array alignment



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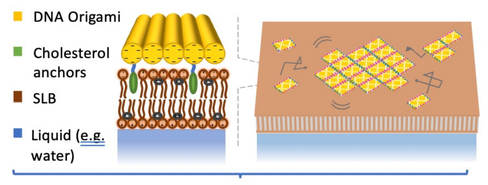
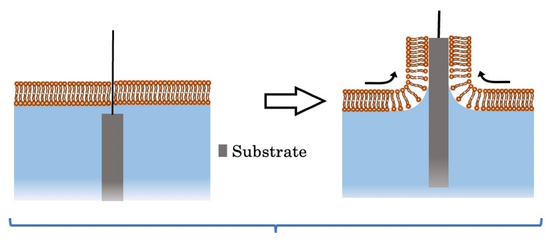
WP7 – Transfer to Flexible Substrates

- Generating DNA origami array on lipid-bi-layer
  - Large-scale arrangement by DNA self-organisation and side-specific binding
  - Anchor points for higher array stability
- Transfer to flexible substrate by Langmuir-Blodgett
  - Suitable process parameters for stable LBL
  - Polymer sheet (PS, …), tissue, paper
- Providing safe-by-design concept
  - Concept of safety during process and for application



1. DNA Origami arrangement on LBL



2. Pulling out of the substrate and attachment of LBL

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