Postdoctoral Position

Nano-optical trapping combined to fluorescence microscope

The Institut Fresnel is a research state laboratory based in Marseille / France, devoted to research and higher education. Institut Fresnel is seeking to recruit talented, enthusiastic young scientists who are highly motivated to boost their research career in nanophotonics and related technologies.

Motivation

The successful candidate will be part of the ERC Consolidator Grant project "TryptoBoost" carried out at the Institut Fresnel under the supervision of Jérome Wenger. Our group has acquired a wide expertise in the nanoscale control of light fields in plasmonic nanostructures and its application to enhance fluorescence spectroscopy applications focusing on single molecules [1-6].

Our next project aims at efficiently monitoring single proteins using their fluorescence enhanced by optical nanoantennas. The plasmonic optical nanoantennas enable single protein analysis at the physiologically relevant micromolar concentrations thanks to the localization and enhancement of light-matter interactions at the nanoscale.

Ensuring that the target protein is located in the most suitable position respective to the nanoantenna is the key to take maximum benefit from the phenomenon of enhanced fluorescence. To this end, we want to implement nano-optical trapping [7-9] to accurately locate the protein target in the antenna hot spot for long investigation times.

Research program

Very recently, nano-optical trapping has been demonstrated to trap a single protein in the gap of a double nanohole antenna [8,9]. However, the transmission measurements used in these earlier works were limited to a very small contrast in the signal change induced by the presence of the protein. In stark contrast, our unique combination with time-resolved fluorescence will enable a much better background-free signal.

Our detection will take advantage of our time-resolved fluorescence spectroscopy techniques and advanced nanonantenna designs [1-6], which are unique in this field. We aim at developing at microscope setup combining an infrared laser to perform the trapping with a visible laser to monitor the fluorescence. The combination with time-resolved techniques will allow to quantify various parameters (trapping force, position and temperature of trapped object,…) with unprecedented spatiotemporal resolutions.

Job description

To strengthen our multidisciplinary team, we are seeking for a physicist with expertise in experimental nanophotonics, plasmonics and/or optical trapping.

The successful candidate will be responsible for the development of the nanooptical trapping microscope combined to single molecule fluorescence spectroscopy. He/She will take part in the experiment development, nano-optical trap characterization, and fluorescence analysis.

The selected Postdoc researcher will work under the supervision of Jerome Wenger and benefit from direct mentorship to further develop his/her career.

Required qualifications – Eligibility

To apply for the postdoctoral contract, candidates must hold an internationally-recognized PhD degree in Physics or Engineering.

Experience in a scientific project involving either nanophotonics, optical microscopy, single molecule fluorescence techniques, and/or optical trapping will be highly appreciated.

No restrictions of citizenship apply to the postdoctoral contract.

Terms of employment – Postdoc

The position is intended as full-time (38 hrs / week, 12 months / year) appointment under CNRS contract. The contracts are offered for two years and can be extended for a supplementary year.

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Application procedure

Suitable candidates are requested to submit:

- a Curriculum Vitae, including a fully referenced list of publications
- a presentation letter with declaration of interests and a description of your past achievements (max. 2 pages)
- contact email of three potential references

Applications should be submitted by email to jerome.wenger@fresnel.fr.

Selection is based on merit and potential, measured in terms of the academic record and personal achievements. Proactivity, participation in community activities, and capacity for team-work are also taken into account.

The call will remain open until positions are filled.

Web Links

www.jeromewenger.com www.fresnel.fr/mosaic

References

Selection of recent publications from the group:

1. P. M. Winkler, R. Regmi, V. Flauraud, J. Brugger, H. Rigneault, J. Wenger, M. F. García-Parajo, *Transient Nanoscopic Phase Separation in Biological Lipid Membranes Resolved by Planar Plasmonic Antennas*, ACS Nano **11**, 7241-7250 (2017).
2. V. Flauraud, R. Regmi, P. M. Winkler, D. T. L. Alexander, H. Rigneault, N. F. van Hulst, M. F. Garcia-Parajo, J. Wenger, J. Brugger, *In-Plane Plasmonic Antenna Arrays with Surface Nanogaps for Giant Fluorescence Enhancement,* Nano Lett. **17**, 1703-1710 (2017).
3. J. de Torres, M. Mivelle, S. B. Moparthi, H. Rigneault, N. F. Van Hulst, M. F. García-Parajó, E. Margeat, J. Wenger, *Plasmonic Nanoantennas Enable Forbidden Förster Dipole-Dipole Energy Transfer and Enhance the FRET Efficiency*, Nano Lett. **16**, 6222-6230 (2016).
4. P. Ghenuche, M. Mivelle, J. de Torres, S. B. Moparthi, H. Rigneault, N. F. Van Hulst, M. F. García-Parajó, J. Wenger, *Matching Nanoantenna Field Confinement to FRET Distances Enhances Förster Energy Transfer Rates*, Nano Lett **15**, 6193-6201 (2015).
5. P. Ghenuche, J. de Torres, S. B. Moparthi, V. Grigoriev, J. Wenger, *Nanophotonic Enhancement of the Förster Resonance Energy-Transfer Rate with Single Nanoapertures*, Nano Lett **14,** 4707-4714 (2014).
6. D. Punj, M. Mivelle, S. B. Moparthi, T. van Zanten, H. Rigneault, N. F. van Hulst, M. F. Garcia-Parajo, J. Wenger, *A plasmonic 'antenna-in-box' platform for enhanced single-molecule analysis at micromolar concentrations*, Nature Nanotech. **8**, 512-516 (2013).
7. Juan, M. L., Righini, M., Quidant, R. *Plasmon nano-optical tweezers*. Nature Photonics **5**, 349-356 (2011).
8. Pang, Y., Gordon, R. *Optical trapping of a single protein.* Nano Lett, **12**, 402-406 (2012).
9. Al Balushi, A. A., Gordon, R. A *Label-Free Untethered Approach to Single-Molecule Protein Binding Kinetics.* Nano Lett., **14**, 5787-5791 (2014).

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