Plasmonic Optical Nanoantennas

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Dr. Ruggero Verre is a post-doctoral researcher in the Department of Applied Physics at the Chalmers University of Technology. His work in the group, headed by Prof. Mikael Käll, focuses on optical antennas: devices that are capable of amplifying and manipulating light on the nanoscale.

APPLICATION

Gold and silver particles are used for this application and, in this form, are known as plasmonic antennas. The applications of plasmonic antennas are numerous: they have been proposed as the key to the next generation of solar cells, as biological sensors and as an amplifier of optical signals to answer fundamental questions on the interaction between light and matter at the nanoscale.

To benefit from the properties of plasmonic antennas in real life, the first step is to unveil, in simple terms, how plasmonic antennas work. Due to their nanoscale nature however, *"characterizing plasmonic nanoantennas was the biggest challenge prior to coming across cathodoluminescence,"* explains Dr. Verre.

CATHODOLUMINESCENCE

A solution to this problem is to use a beam of fast electrons to probe materials at the nanoscale and to observe the light that is emitted. This principle is called cathodoluminescence, and enables the retrieval of optical properties with deep sub-wavelength resolution.

THE SPARC SYSTEM

The SPARC is a high-performance cathodoluminescence detection system. With a unique high-precision automated mirror stage, the SPARC opens up new avenues of research such as the study of electron beam induced nanophotonics.

The higher detection efficiency of the SPARC not only leads to better results, but also makes it possible to do a new type of nanophotonics research: angle-resolved measurements. This makes the SPARC system one of a kind. With this new detection method, the direction in which the light is emitted from an excited structure can be mapped.

> *"I see two technical advantages. The first is the mirror design which may be moved in all directions including rotation. These degrees of freedom allow us to achieve precise and reproducible control for repeatable results. The angle-resolved possibilities with ad-hoc analysis have the potential to be most useful. The SPARC system was designed with the idea to image the angular light emissions of different structures using a CCD camera. However, analysis and development of the ability to generate results was not straightforward. DELMIC has developed an integrated solution and provided excellent one-to-one support which has been of help to our research."*