

Exchange Grant Application Final Report

Prof. Stefan Maier, Imperial College London

Institute to be visited: Donostia International Physics Centre, San Sebastian, Spain

Collaborator: Dr. Javier Aizpurua, Head of Nanophotonics Group

Duration of stay: July 15th – August 12th 2011

Previous interactions:

I know Dr. Aizpurua for about 5 years, and we have actively started to collaborate on the design and investigation of plasmonic nanocavities, mainly using methods based on electron energy loss spectroscopy, for about 18 months now. Currently, we are writing up our first joint publication for the journal *Small*, on the topic of correlation between optical and electron spectroscopies of colloidal metallic nanoshells, from a viewpoint of using these as substrates for surface enhanced Raman scattering.

Scientific aims of the proposed visit:

Goal of this visit is to put our collaborations in the area of nanophotonic cavities on a new level, via starting a couple of distinct programs of work aligned to the goals of our network PLASMON-BIONANOSENSE, in particular:

- Theoretical descriptions of cavity – nanowaveguide coupling phenomena, particularly in terms of determining whether electron energy loss spectroscopy can be developed into a useful tool for assessing the nanofocusing of travelling surface plasmon polaritons into nanocavities (which will act as sensing hot spots)
- Theoretical investigations into setting up figures of merit for light/matter interactions employed in nano-biosensing: surface enhanced Raman spectroscopy, surface enhanced infrared absorption spectroscopy, localized surface plasmon resonance sensing, THz/GHz absorption spectroscopy, etc.
- Together with the group of Rainer Hillenbrand at NanoGune (also in San Sebastian), set up of a near-field microscopy imaging scheme particularly suited for assessing mid-infrared and THz micro/nano-cavities for surface enhanced infrared absorption spectroscopy

We of course anticipate that the visit will yield further scientific outcomes not even envisaged at this stage. In order to proceed with maximum efficiency after the initial one-month period, three members of Prof. Maier's team will visit for a

couple of days each during this month, in order to build direct links with team members of Dr. Aizpurua's group.

Outcome:

- Representation of ESF network and presentation about ESF given (in my capacity as chair) in a public seminar at the Donostia International Physics Centre and NanoGune; discussions and advertisement of the network to the directors of these two institutions
- Furthermore representation of ESF network and presentation about ESF at the University of Cantabria in Santander
- Scientific work with Dr Aizpurua's group on nanocavities has lead to one joint publication, which we are currently writing, concerning the investigation of metallic nano shells using high-energy electron beams, to assess their potential for field enhancement for biological sensing
- Two senior researchers in my group and in Dr. Aizpurua's group have now started working together on a daily basis, on theoretical research into nanocavities
- Two of my group members (Drs Giannini and Sonnefraud) visited for 3 days during my stay (also ESF funded) in order to further collaborations with Donostia International Physics Centre and NanoGune