

BENIAMINO SCIACCA, PhD

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CURRENT POSITION

CNRS Research Scientist working at the Institute CINaM (Marseille)

Dr. Beniamino Sciacca is a scientist whose research activities lie in the edge between physics, chemistry and nanotechnology. He is involved in the synthesis and characterization of nanomaterials for nano-enabled photovoltaics, in light-matter interaction at the nanoscale and in the realization of devices (single nanowire and large scale) for solar energy conversion. He has expertise in the domain of photovoltaics, synthesis and characterization of nanomaterials, thin films, optics, plasmonics, surface plasmon resonance, surface functionalization, biosensing.

EDUCATION

High Qualified Research Doctor – Politecnico di Torino, 2010

“Nanotechnologies and nanostructured innovative materials” (Materials Science), under the supervision of Prof. Francesco Geobaldo Thesis: “Porous silicon nanostructures for biosensing devices”, with the mention: “The Board unanimously assessed as excellent his research work”. Recognition as “European Doctorate”, fulfilling all the criteria required by the European University Association.

Alta Scuola Politecnica Diploma – 2007

(<http://www.asp-poli.it>); mention: “with merit”

M.S. in Biomedical engineering, Politecnico di Milano – 2006

M.S. in Biomedical engineering, Politecnico di Torino – 2006

with the mention “cum laude”. Thesis: “A molecular mechanics study of the interaction between microcantilever and DNA fragments”, under the supervision of Prof. Franco Montevicchi.

B.S. in Biomedical engineering, Politecnico di Torino – 2004

with the mention “cum laude”. Thesis: “Electrical characterization of micro-electrode matrices: noise measurement”, under the supervision of Prof. Marco Knaflitz.

RESEARCH EXPERIENCES

Research Scientist, TNO; Eindhoven, Netherlands - 2017-2018

Developed a new concept for mid-infrared based gas sensing, based on the combination of resonant antennas with concentrating coatings. Also worked on the investigation and characterization of new dyes for fast STED lithography.

Research Scientist, ASML; Veldhoven, Netherlands - 2017

Introduced a new concept mark for wafer alignment, based on the modulation of the amplitude of diffracted light by a resonant grating.

Senior postdoc, FOM Institute AMOLF; Amsterdam – 2013-2016

Advisor: Dr. Erik Garnett

Worked on nanoscale solar cells. Involved in the *synthesis* (solution phase) and *characterization* (structural, compositional, optical, electrical) of metal-semiconductor core-shell nanowires as building blocks for efficient and inexpensive solar cells. Light management in photovoltaics (*nanophotonics*): involved in the development of optical microscopy techniques to characterize quantitatively individual nanostructures. Also worked on the realization of monocrystalline transparent electrodes based on ordered array of metal nanowires from nanocube building blocks. Involved on design (*simulations*) and *devices* fabrication of core-shell nanowires arrays for large scale photovoltaics.

Research Associate, Institute for Photonics & Advanced Sensing; Adelaide (Australia) – 2011-2012

Advisor: Prof. Tanya Monro

Worked on the development of optical fiber-based surface plasmon resonance biosensors for early stages diagnosis of gastric cancer. Developed the radiative-SPR platform to allow for the multiplexed detection of multiple biomarkers simultaneously real-time to be applied both as a diagnostic tool and in Proteomics research. Work involved improvements in the platform architecture and in the surface functionalization. Developed also a dip sensing architecture based on localized surface plasmons for multiplexed detection of biomarkers.

PhD student, Politecnico di Torino; – 2006-2010

Advisor: Prof. Francesco Geobaldo

Worked on the development of 1D porous silicon photonics nanostructures for sensing. Explored several approaches for label free (e.g. porous silicon multilayer supporting surface waves) and fluorescence based sensing (e.g. doubly resonant porous silicon microcavity for fluorescence enhancement of labeled protein). Developed a porous silicon based nanoreactor for the real time detection of ROS species by means of hybrid resonant microcavity.

Visiting student, University of Montpellier; – May-August 2009

Advisor: Dr. Frederique Cunin

Developed a hybrid material porous silicon/chitosan to detect low concentrated pollutants in water.

Visiting student, UCSD; San Diego (USA); – May-November 2008

Advisor: Prof. Michael Sailor

Developed a novel functionalization route to modify the surface chemistry of thermally carbonized porous silicon chips for further bioconjugation chemistry for the development of biosensors with an improved stability in buffer solutions.

SKILLS AND TECHNIQUES

- Synthesis of porous silicon thin film optical structures (resonant microcavities, bragg mirrors, rugate filters)
- Synthesis of nanomaterials: nanowires, nanoparticles, metal-semiconductor core-shell heterostructures; primarily via solution phase
- Functionalization via surface chemistry for bioconjugation;
- Characterization of nanomaterials:
 - **Chemical:** FT-IR, Raman spectroscopy, EDS, XRD
 - **Structural:** SEM, TEM (analysis), SAED (analysis)
 - **Optical:** Photoluminescence lifetime, Interferometry, UV-Vis, Ellipsometry, Single nanowire quantitative absorption measurement, scanning photocurrent measurements, SNOM, Confocal microscopy.
 - **Topological:** AFM, low voltage SEM (20V-100 V) highly sensitive to surface texturing and elemental composition
 - **Electrical:** I-V characteristics of nanowire devices
- Self-assembly of nanomaterials in arbitrary pattern.
- Nanofabrication/Cleanroom: optical lithography, e-beam lithography, metallization (thermal, sputtering, e-beam) etching, Focused Ion Beam.
- Realization of Immunoassays for biosensing: SPR on planar substrate, SPR on optical fibers, LSPR on metal nanoparticles.
- Experimental optics for building characterization setups
- Modeling of 1D photonic structures (Transfer matrix method) and rigorous coupled wave analysis for grating-like structured multilayers
- FDTD (Lumerical)
- Programming: Matlab, C, Simulink, IgorPro
- FEM: Hypermesh, Patran, Ansys, Femlab

TRAINING AND ACTIVITIES

- School "Quantsol", organized by HZB, Hirscheegg, Austria (2014)
 - School "Materials for renewable energy", organized by MRS, Erice, Italy (2014)
 - School of "Microfluidic devices", FSRM, Wien, Austria, (2009).
 - School of "Biosensors", directed by Prof. F. Pirri, Vipiteno, Italy, (2009).
 - School of "Photochemistry", directed by Prof. V. Balzani, Bologna, Italy, (2007)
 - Designed and built an analog device for the detection of organic vapour, based on a porous silicon resonant microcavity.
 - Peer reviewer for Advanced Materials, Advanced Electronic Materials, JACS, Sensors and Actuators B, Langmuir, Optics Express
 - Mentoring of PhD, Master and Bachelor students
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- Invited lecture at the 'Sigma Symposium', University of Nijmegen: "Core-shell nanowires for photovoltaics" (2014)
 - Invited lecture at the Amsterdam University College: "Core-shell nanowires for photovoltaics" (2015)
 - Invited seminar at the INL - Institute des Nanotechnologies de Lyon (FR): "Nanostructured materials for energy photonics and sensing" (2015)
 - Invited seminar at the LTM - Laboratoire des Technologies de la Microelectronique, Grenoble (FR): "Nanostructured materials for energy photonics and sensing" (2016)
 - Author of >10 talks at international conferences - 1 invited.

AWARDS

Best talk in the conference NANOSMAT 2007, symposium "porous semiconductors", title: "Controlled light emission and propagation in porous silicon resonant multilayers", (2007).

Winner of a national scholarship granted by MIUR-INAIL - 2003-2004

PUBLICATIONS

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- (1) "Nanoscale chiral valley-photon interface through optical spin-orbit coupling", Gong et al., *Science*, 359, 443-447 (2018)
 - (2) "Monocrystalline Nanopatterns Made by Nanocube Assembly and Epitaxy", **B. Sciacca** et al., *Advanced Materials*, 29, (2017)
 - (3) "Integrating sphere microscopy for direct absorption measurements of single nanostructures", Mann et al., *ACS nano*, 11, 1412-1418 (2017)
 - (4) "3D Multi-Energy Deconvolution Electron Microscopy", de Goede et al., *Nanoscale*, 9, 684-689, (2017)
 - (5) "Effect of surface roughness on metal enhanced fluorescence in planar substrates and optical fibers", E. Klatsataya et al., *Optical Materials Express*, 6, 2128 (2016)
 - (6) "AgFeS₂-Nanowire-Modified BiVO₄ Photoanodes for Photoelectrochemical Water Splitting", X. Zheng et al., *ChemPlusChem*, 81, (2016)
 - (7) "Solution-grown silver nanowire ordered arrays as transparent electrodes", **B. Sciacca** et al., *Advanced Materials*, 28, 905-909 (2016)
 - (8) "Transformation of Ag nanowires into semiconducting AgFeS₂ nanowires", **B. Sciacca** et al., *Journal of the American Chemical Society*, 137, 4340-4343 (2015)
 - (9) "Au-Cu₂O core-shell nanowire photovoltaics", S. Oener et al., *Applied Physics Letters*, 106, 023501 (2015)
 - (10) "Solution-Phase Epitaxial Growth of Quasi-Monocrystalline Cuprous Oxide on Metal Nanowires", **B. Sciacca** et al., *Nano Letters*, 14, 5891-5898 (2014).
 - (11) "Lanthanide Luminescence Enhancements in Porous Silicon Resonant Microcavities", A. Jenie et al., *ACS Appl. Mat. Interfaces*, 6, 12012-12021 (2014).
 - (12) "A dip biosensor based on localized surface plasmon resonance at the tip of an optical fiber", **B. Sciacca** et al., *Langmuir*, 30, 946-954 (2014).
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- (13) "Surface modification of porous silicon microparticles by sonochemistry", S. Pace et al., RSC Advances, 3, 18799-18802, (2013).
 - (14) "Multiplexing of radiative-surface plasmon resonance for the detection of gastric cancer biomarkers in a single optical fiber", **B. Sciacca** et al., Sensors and Actuators B: Chemical, 183, 454-458 (2013).
 - (15) "Radiative-Surface Plasmon Resonance for the detection of apolipoprotein E in medical diagnostics applications", **B. Sciacca** et al., Nanomedicine: NBM, 9, 550-557 (2013).
 - (16) "Switching of fluorescence mediated by a peroxydinitrite–glutathione redox reaction in a porous silicon nanoreactor", **B. Sciacca** et al., Physical Chemistry Chemical Physics, 14, 5251-5254 (2012).
 - (17) "Chitosan functionalized porous silicon optical transducer for the detection of carboxylic acid-containing drugs in water", **B. Sciacca** et al., Journal of Material Chemistry, 21, 2294-2302 (2011).
 - (18) "Bioconjugate functionalization of thermally carbonized porous silicon using a radical coupling reaction", **B. Sciacca** et al., Dalton transactions, 39, 10847-10853 (2010).
 - (19) "Fast optical vapour sensing by Bloch surface waves on porous silicon membranes", F. Michelotti et al., Physical Chemistry Chemical Physics, 12, 502-506 (2010).
 - (20) "Doubly resonant porous silicon microcavities for enhanced detection of fluorescent organic molecules", **B. Sciacca** et al., Sensors and actuators B: Chemical, 137, 467-470 (2009).
 - (21) "Coupling of surface waves in highly defined one-dimensional porous silicon photonic crystals for gas sensing applications", E. Descrovi et al., Applied Physics Letters 91, 241109(1)-241109(3) (2007).
 - (22) "ASP studies on fluorine in biomedicine: two innovative applications". Navarrini, W., et al., Chimica Oggi-Chemistry Today, **25**(3): p. 48-50 (2007).

PATENTS

- (1) "Method for manufacturing a patterned monocrystalline film and such a patterned monocrystalline film", #2016849 (*granted*)
- (2) "Resonant Amplitude Marks: a novel alignment mark family that is insensitive to process-induced asymmetries", #17197914.9EP (*filed*)
- (3) "Gas sensing via concentrated coatings supported on infrared resonant nanoantennas", #18182298.2EP (*filed*)

LANGUAGES

Italian, English, French.

REFERENCES

- Dr. Erik Garnett, FOM Institute AMOLF (garnett@amolf.nl)
 - Prof. Albert Polman, FOM Institute AMOLF (polman@amolf.nl)
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- Prof. Michael Sailor, University of California San Diego (msailor@ucsd.edu)
 - Prof. Francesco Geobaldo, Politecnico di Torino (francesco.geobaldo@polito.it)
 - Dr. Frederique Cunin, University of Montpellier (frederique.cunin@enscm.fr)
 - Prof. Marijn van Huis, Utrecht University (M.A.vanHuis@uu.nl)
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