EPFL VALAIS WALLIS
LABORATORY OF NANOCHEMISTRY FOR ENERGY (LNCE)

Prof. Raffaella Buonsanti Tel.: +4121 695 8287

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Raffaella Buonsanti: Curriculum vitae

PERSONAL INFORMATION

Tenure-track Assistant Professor in Chemical Sciences and Engineering
École Polytechnique Fédérale de Lausanne
Born in Tricarico (MT), Italy, on May 21st, 1981

EDUCATION

Postdoctoral fellow, adviser: Prof. D. Milliron 2010 - 2012
Molecular Foundry, Lawrence Berkeley National Laboratory

PhD in Nanoscience, adviser: Prof. D.P. Cozzoli 2006 - 2010
National Nanotechnology Laboratory, University of Salento, Lecce, Italy

Master Degree in Chemistry, advisers: Prof. D.P. Cozzoli, Prof. A. Agostiano 2000 - 2006
University of Bari, Italy

Secondary Education Liceo Scientifico "Dante Alighieri" 1995 - 2000
Matera, Italy

ACADEMIC POSITIONS

Tenure-track Assistant Professor at ISIC-EPFL 2015 -

Tenure-track Staff Scientist and Principal Investigator 2013 - 2015
at the Joint Center for Artificial Photosynthesis
MSD-Lawrence Berkeley National Laboratory

Project Scientist at the Molecular Foundry, Inorganic Facility 2012 - 2013
Lawrence Berkeley National Laboratory

AWARDS

European Research Council (ERC) Starting Grant 2016

Assistant Professor Energy Grant from Swiss National Science Foundation 2016

Laboratory Directed Research and Development (LDRD) from Lawrence Berkeley National Laboratory 2014

R&D 100 Award (USA) 2013

Outstanding Mentors Award from the CSEE (Center for Science and Engineering Education) 2011
Lawrence Berkeley National Laboratory

FUNDING

Swiss National Science Foundation, Scientific Exchange Grant N° IZSEZ0_177984 2017
Title: "1st Winter School at EPFL Valais: Challenges and Opportunities in Energy Research"

Academic host for Dr. Michal Strach, Recipient of the Marie Curie Individual Fellowship 2017
Title: "NANOAID: Advanced in-situ techniques for the development of metal oxide nanostructures"

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Swiss National Science Foundation, AP Energy Grant N° PYAPP2_166897/1 2016
Title: "Colloidal chemistry for engineering complex metal oxides to advance solar-to-fuels conversion studies"

ERC-STG-Grant 2016
Title" HYCAT: multifunctional hybrid platforms based on colloidal nanocrystals to advance CO_2 conversion studies"

Gaznat Research Grant 2016
Title: "Electrochemical conversion of CO_2 into value-added chemicals"

Project Grant in National Center of Competence in Research MARVEL 2016
Title "Colloidal nanocrystals as model systems to uncover structure/properties relation in CO_2 electroreduction"

Academic host for Dr. Anna Loiudice, Recipient of the Marie Curie Reintegration Fellowship 2016
Title: "NanoINCAGE: Luminescent nanocrystals in a cage for solar-to-fuels conversion"

TEACHING:

Master Course EPFL: Nanomaterials for chemical engineering applications 2018 -

Doctoral Course EPFL: Colloidal synthesis of nanoparticles and their energy applications 2017 -

Bachelor Course EPFL: Introduction to transport phenomena 2017 -

Guest Lecturer in UC Berkeley, Materials Science Department: 2014 - 2015
Introduction to nanoscience and engineering

PROFESSIONAL SERVICES/INSTITUTIONAL RESPONSABILITIES

Chair of the 1st Winter School EPFL Valais 2017-
"Challenges and Opportunities in Energy Research"
March 5th - 9th 2018, Crans-Montana (https://nrg2018.epfl.ch)

Member of the EPFL teaching committee of Chemistry and Chemical Engineering 2017 -

Chair of EPFL Valais monthly Faculty Meetings 2016 -

Member of the Molecular Foundry User Executive Committee 2014 - 2015

LBNL Safety Advisory Board member 2014 - 2015

Editorial Board Member for Nature Scientific Reports 2013 - 2016

Member of the User Proposal Review Board at the Molecular Foundry 2013 -

Reviewer for Journal of American Chemical Society, Chemistry of Materials, Advanced Materials, Advanced Functional Materials, Chemical Communications, Journal of Materials Chemistry, Physical Chemistry Chemical Physics, Chemical Science, ACS Catalysis, Nature Communications, Nature Catalysis.

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INVITED TALKS AND DEPARTMENT SEMINARS

- Invited talk at MRS Fall Meeting 2017, Symposium NM6 "Semiconductor nanocrystals, plasmonic nanoparticles and metal-hybrid structures November 26th- December 1st, Boston
- Invited seminar at the King's College London, November 15th 2017
- Invited seminar at the University of Geneva, Department of Chemistry, September 26th 2017 "Colloidal chemistry to advance solar-to-chemicals conversion studies".
- Invited talk at Euromat 2017, Symposium "Colloidal nanoparticles: synthesis, functionalization and applications" Thessaloniki, Greece, September 17th-22nd 2017
- Invited seminar at the University of Oslo, September 4th, 2017
- Invited talk at 21st Solid State Ionic Conference, Symposium Photochemical and photocatalystic energy conversion, June 18th-23rd, Padua, Italy
- Invited talk SCNAT 10th Young Faculty Meeting, June 6th, Bern, Switzerland
- Invited seminar in Materials Science Seminar Series at EPFL, March 13th 2017
- Invited seminar at LMU, Munich, January 9th 2016
- Invited seminar at Fudan University, Shangai, November 14th 2016
- Plenary Lecture at the Royal Society of Chemistry Conference ISACS21 Challenges in Nanoscience 2017, November 10th-12th, Beijing
- Invited seminar at the Paul Scherrer Institute, June 15th 2016
- Invited seminar at the Department of Chemistry and Biochemistry at the University of Bern "Colloidal Chemistry to Advance Energy Conversion Studies", April 28th 2016
- Invited talk ""Nanocrystal-based 3D hierarchical electrodes for solar to fuel conversion" at The Molecular Foundry User Meeting 2014
- Invited talk *"Manipulating nanocrystal doping, structure and photocatalytic activity with organic ligands"* ACS Meeting 2014, San Francisco
- Invited talk *"Colloidal chemistry for photoanode material discovery"* Spring EMRS 2014, Lille
- Invited talk *"Nanocrystal-based hierarchical photoelectrodes for artificial photosynthesis"* Spring MRS 2014, San Francisco (CA)

PUBLICATIONS

As of October 2017, Professor Raffaella Buonsanti has co-authored **52 peer-review publications** in international journals. These publications have received over 2300 literature citations and an **h-index of 25** (without self-citations, data from SCOPUS)

52) A. Loiudice+, S. Saris+, E. Oveisi, D.T.L. Alexander, R. **Buonsanti*** "$CsPbBr_3$ QD/AlOx inorganic nanocomposites with exceptional stability in water, light and heat" *Angew. Chem. Int. Ed.* **2017**, 56, 10696.
51) L. H. Hess, J.K. Cooper, A. Loiudice, C.-M. Jiang, **R. Buonsanti***, I.D. Sharp* "Probing interfacial energetics and charge transfer kinetics in semiconductor nanocomposites: New insights into heterostructured $TiO_2/BiVO_4$ photoanodes" *Nano Energy* **2017**, 34, 375.
50) I. D. Sharp*, J. K. Cooper, F. M. Toma, **R. Buonsanti** "Bismuth vanadate as a platform for accelerating discovery and development of complex transition metal oxide photoanodes", *ACS Energy Letters* **2017**, 2, 139.
49) C. Gadiyar, A. Loiudice, **R. Buonsanti*** "Colloidal nanocrystals for photoelectrochemical and photocatalytic water splitting", *J. Phys. D: Appl. Phys.* **2017**, 50, 074006
48) **R. Buonsanti*** "Colloidal Chemistry to Advance Studies in Artificial Photosynthesis" *Chimia* **2016**, 70, 780.
47) I. Luz+, A. Loiudice+, D.T. Sun. W. L. Queen, **R. Buonsanti*** "Understanding the formation mechanism of metal

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nanocrystal@MOF-74 hybrids" *Chem. Mater.* **2016**, 28, 3839.
46) A. Loiudice, P. Lobaccaro, E.A. Kamali, T. Thao, B.H. Huang, J.W. Ager, **R. Buonsanti*** "Tailoring Copper Nanocystals towards C2 Products in Electrochemical CO2 reduction" *Angew. Chemie. Int. Ed.* **2016**, 55, 5789

Prior to EPFL:
45) A. Loiudice, J. K. Cooper, L. H. Hess, T. M. Mattox, I. D. Sharp*, **R. Buonsanti*** "Assembly and Photocarrier Dynamics of Heterostructured Nanocomposite Photoanodes from Multicomponent Colloidal Nanocrystals" *Nano Lett.* **2015**, 15, 7347.
44) S.M. Meckler, C. Li, W. L. Queen, T. E. Williams, J. R. Long, **R. Buonsanti**, D. J. Milliron, and B. A. Helms "Sub-micron Polymer–Zeolitic Imidazolate Framework Layered Hybrids via Controlled Chemical Transformation of Naked ZnO Nanocrystal Films" *Chem. Mater.* **2015**, doi: 10.1021/acs.chemmater.5b03219.
43) A. Loiudice, J. Ma, W. S. Drisdell, T. M. Mattox, J. K. Cooper, T. Thao, C. Giannini, J. Yano, L.-W. Wang, I. D. Sharp, **R. Buonsanti*** "Band-gap tunability in Sb-alloyed $BiVO_4$ quaternary oxides as visible light absorbers for solar fuel applications" *Adv. Mater.* **2015**, 27, 6733.
42) B. A. Helms, T.E. Williams, **R. Buonsanti**, D.J. Milliron "Colloidal Nanocrystal Frameworks" *Adv. Mater.* **2015**, 27, 5820.
41) J. Lynch, C. Giannini, J. K. Cooper, A. Loiudice, I. D. Sharp, **R. Buonsanti*** "Substitutional or interstitial site-selective nitrogen doping in TiO_2 nanostructures" *J. Phys. Chem.* C **2015**, 119, 7443.
40) R. Sharma, A. Sawvel1, B. Barton, A. Dong, **R. Buonsanti**, S. Axnanda, Z. Liu, J. J. Urban, D. Nordlund, C. Kisielowski, D. J. Milliron "Modulation of carrier type by interface doping in ultrathin semiconductor nanocrystal-in-matrix composites", *Chem. Mater.* **2015**, 27, 2755.
39) Y. Li, J.K. Cooper, **R. Buonsanti**, C. Giannini, Y. Liu, M. F. Toma, I. D. Sharp "Fabrication of highly efficient planar heterojuction perovskite solar cells by controlled low-pressure vapor annealing" *J. Phys. Chem. Lett.* **2015**, 6, 493.
38) C. Kim, P. J. Phillips, L. Xu, A. Dong, **R. Buonsanti**, R. F. Klie, J. Cabana "Stabilization of Battery Electrode/Electrolyte Interfaces Employing Nanocrystals with Passivating Epitaxial Shells" *Chem. Mater.* **2015**, 27, 394.
37) T. E. Williams, C. M. Chang, E. L. Rosen, G. Garcia, E. L. Runnerstrom, B. L. Williams, B. Koo, **R. Buonsanti**, D. J. Milliron, B. A. Helms "NIR-selective electrochromic heteromaterial framework: a platform to understand mesoscale transport phenomena in solid-state electrochromical devices" *J. Mater. Chem. C* **2014**, 2, 3328.
36) D. J. Milliron, **R. Buonsanti**, A. Llordes, B. A. Helms "Constructing Functional Mesostructured Materials from Colloidal Nanocrystal Building Blocks" *Acc. Chem. Res.* **2014**, 47, 236.
35) A. Bergerund, **R. Buonsanti**, J. L. Jordan-Sweet, D. J. Milliron "Synthesis and Phase Stability of Metastable Bixbyite V2O3 Colloidal Nanocrystals" *Chem. Mater.* **2013**, 25, 3172
34) L. Di Trizio, **R. Buonsanti**, A. Schimpf, D. R. Gamelin, R. Simonutti, D. J. Milliron "Nb-Doped Colloidal TiO_2 Nanocrystals with a Tunable Localized Surface Plasmon Resonance" *Chem. Mater.* **2013**, 25, 3383.
33) I. Gurevitch, **R. Buonsanti**, A. A. Teran. B. Gludovatz, R. O. Ritchie, J. Cabana, N. P. Balsara,"Nanocomposites of Titanium Dioxide and Polystyrene-Poly(ethylene oxide) Block Copolymer as Solid-State Electrolytes for Lithium Metal Batteries" *J. Electrochem. Soc.* **2013**, 160, A1611-A1617.
32) C. Kim, **R. Buonsanti**, R. Yaylian, D. J. Miliron, J. Cabana "Carbon-free TiO_2 battery electrodes enabled by morphological control at the nanoscale" Adv. Ener. Mater. **2013**, 3, 1286.
31) J. B. Rivest, R. Buonsanti, T. E. Pick, L. Zhu, B. A. Helms, D. J. Milliron "Ordered mesoporosity in chalcogenide thin films" *J. Am. Chem. Soc.* **2013**, 135, 7446.
30) **R. Buonsanti***, D. J. Milliron* "Chemistry of doped colloidal nanocrystals" *Chem. Mater.* **2013**, 25, 1305.
29) G. Garcia, **R. Buonsanti**, A. Llordes, E. L. Runnerstrom, A. Bergerud, D. J. Milliron "Near Infrared Spectrally Selective Plasmonic Electrochromic Coatings" *Adv. Opt. Mater.* **2013**, 1, 215.

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28) A. M. Schimpf, S. T. Ochsenbein, **R. Buonsanti**, D. J. Milliron, D. R. Gamelin "Comparison of extra electrons in colloidal n-type Al^{3+}-doped and photochemically reduced ZnO nanocrystals" *Chem. Commun.* **2012**, 48, 9352.
27) **R. Buonsanti**, T. E. Pick, N. Krins, T. J. Richardson, B. A. Helms, D. J. Milliron "Assembly of Ligand-Stripped Nanocrystals into Precisely Controlled Mesoporous Architectures" *Nano Lett.* **2012**, 12, 3872
26) B. Barton, **R. Buonsanti**, A. Dong, D. Milliron, L. Hansen, S. Helveg, B. Jiang and C. Kisielowski "The challenge of imaging hard/soft matter interfaces at atomic resolution" *Microscopy and Microanalysis* **2012**, 18, 1606.
25) J. T. Duong, M. J. Bailey, T. E. Pick, P. M. McBride, E. L. Rosen, **R. Buonsanti**, D. J. Milliron, B.A. Helms "Efficient polymer passivation of ligand-stripped nanocrystal surfaces" *J. Polymer Sci. A: Polymer Chemistry* **2012**, 50, 3719
24) I. E. Rauda, **R. Buonsanti**, L. C. Saldarriaga-Lopez, K. Benjauthrit, L. T. Schelhas, M. Stefik, V.Augustyn, J. Ko, B. Dunn, U. Wiesner, D. J. Milliron, and S. H. Tolbert "General Method for the Synthesis of Hierarchical Nanocrystal-Based Mesoporous Materials" *ACS Nano* **2012**, 6, 6386
23) M.G. Manera, A. Taurino, M. Catalano, R. Rella, A.P. Caricato, **R. Buonsanti**, P.D. Cozzoli, M. Martino "Enhancement of the optically activated NO2 gas sensing response of brookite TiO2 nanorods/nanoparticles thin films deposited by matrix-assisted pulsed-laser evaporation" *Sensors and Actuators B: Chemical* **2012**, 161, 869
22) E. Rosen, **R. Buonsanti**, A. Llordes, A. Sawverl D. J. Milliron, B. Helms "Exceptionally Mild Reactive Stripping of Native Ligands from Nanocrystal Surfaces Using Meerwein's Salt" *Angew. Chemie. Int. Ed.* **2011**, 51, 684
21) **R. Buonsanti**, E. Carlino, C. Giannini, D. Altamura, L. De Marco, R. Giannuzzi, M. Manca, G. Gigli, P. D. Cozzoli "Hyperbranched Anatase TiO2 Nanocrystals: Nonaqueous Synthesis, Growth Mechanism, and Exploitation in Dye-Sensitized Solar Cells" *J. Am. Chem. Soc.* **2011**, 133, 19216
20) **R. Buonsanti**, A. Llordes, S. Aloni, B. Helms, D. J. Milliron "Tunable Infrared Absorption and Visible Transparency of Colloidal Aluminum-Doped Zinc Oxide Nanocrystals" *Nano Lett.* **2011**, 11, 4706
19) G. Garcia, **R. Buonsanti**, E.L. Runnerstrom, R. J. Mendelsberg, A. Llordes, A. Anders, T. J. Richardson, D. J. Milliron "Dynamically Modulating the Surface Plasmon Resonance of Doped Semiconductor Nanocrystals" *Nano Lett.* **2011**, 11, 4415
18) L. De Marco, M. Manca, **R. Buonsanti**, R. Giannuzzi, F. Malara, P. Pareo, L. Martiradonna, N. M. Giancaspro, P. D. Cozzoli, G. Gigli "High-quality photoelectrodes based on shape-tailored TiO2 nanocrystals for dye-sensitized solar cells" *J. Mater. Chem.* **2011**, 21, 13371
17) M. Levy, A. Quarta, A. Espinosa, A. Figuerola, C. Wilhelm, M. Garcia-Hernandez, A. Genovese, A. Falqui, D. Alloyeau, **R. Buonsanti**, P. D. Cozzoli, M. A. Garcia, F. Gazeau, T. Pellegrino "Correlating Magneto-Structural Properties to Hyperthermia Performance of Highly Monodisperse Iron Oxide Nanoparticles Prepared by a Seeded-Growth Route" *Chem. Mater.* **2011**, 23, 4170
16) A. P. Caricato, **R. Buonsanti**, M. Catalano, M. Cesaria, P. D. Cozzoli, A. Luches, M. G. Manera, M. Martino, A. Taurino and R. Rella "Films of brookite TiO2 nanorods/nanoparticles deposited by matrix-assisted pulsed laser evaporation as NO2 gas-sensing layers" *J. Appl.Phys. A* **2011**, 104, 963
15) A. Llordes, A. T. Hammack, **R. Buonsanti**, R. Tangirala, S. Aloni, B. A. Helms, D. J. Milliron "Polyoxometalates and colloidal nanocrystals as building blocks for metal oxide nanocomposite films" *J. Mater. Chem.* **2011**, 21, 11631
14) I. C. Lekshmi, **R. Buonsanti**, C. Nobile, R. Rinaldi, P. D. Cozzoli, G. Maruccio "Tunneling Magnetoresistance with Sign Inversion in Junctions Based on Iron Oxide Nanocrystal Superlattices", *ACS Nano* **2011**, 5, 1731-1738
13) D. Fragouli, B. Torre, G. Bertoni, **R. Buonsanti**, R. Cingolani, A. Athanassiou "Formation and Microscopic Investigation of Iron Oxide Aligned Nanowires Into Polymeric Nanocomposite Films" *Microscopy Research and Tecnique* **2010**, 73, 952-958
12) **R. Buonsanti**, E. Carlino, V. Grillo, C. Giannini, F. Gozzo, M.Garcia-Hernandez, M.A. Garcia, R. Cingolani, P.D. Cozzoli "Architectural Control of Seeded Grown Iron Oxide/TiO_2 Nanorod Heterostructures: The Role of Seeds in Topology Selection" *J. Am. Chem. Soc.* **2010**, 132, 2437–2464

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11) D. Fragouli, **R. Buonsanti**, G. Bertoni, A. Falqui, C. Sangregorio, C. Innocenti, D. Gatteschi, P.D. Cozzoli, A. Athanassiou, R. Cingolani, "Dynamical formation of spatially localized arrays of aligned nanowires in plastic films with magnetic anisotropy." *ACS Nano* **2010**, 4, 1873
10) V. Petkov, P. D. Cozzoli, **R. Buonsanti**, R. Cingolani, Y. Ren "Size, shape and internal atomic ordering of nanocrystals by atomic pair distribution functions: a comparative study of γ-Fe_2O_3 nanosized spheres and tetrapods" *J. Am. Chem. Soc.* **2009**, 131, 14264–14266
9) **R. Buonsanti**, E. Snoeck, C. Giannini, F. Gozzo, M. Garcia-Hernandez, M. A. Garcia, R. Cingolani, P. D. Cozzoli "Colloidal semiconductor-magnetic heterostructures based on iron-oxide-functionalized brookite nanorods" *Phys. Chem. Chem. Phys.* **2009**, 11, 3680-3691
8) R. Di Corato, P. Piacenza, M. Musarò, **R. Buonsanti**, P.D. Cozzoli, M. Zambianchi, G. Barbarella, R. Cingolani, L.Manna, T. Pellegrino "Magnetic-fluorescent colloidal nano-beads: preparation and exploitation in cell separation experiment" *Macromol. Biosci.* **2009**, 9, 952-958
7) **R. Buonsanti**, V. Grillo, E. Carlino, C. Giannini, T. Kipp, R. Cingolani and P. D. Cozzoli "Nonhydrolitic synthesis of high quality anisotropically shaped brookite TiO_2 nanocrystals" *J. Am. Chem. Soc.* **2008**, 130 11223–11233
6) R. Di Corato, A. Quarta, P. Piacenza, A. Ragusa, A. Figuerola, **R. Buonsanti**, R. Cingolani, L. Manna, T. Pellegrino "Water solubilization of hydrophobic nanocrystals by means of poly(maleic anhydride-alt-1-octadecene)" *J. Mater. Chem.* **2008**, 18, 1991-1996
5) G. Caputo, C. Nobile, **R. Buonsanti**, T. Kipp, L. Manna, R. Cingolani, P. D. Cozzoli, A. Athanassiou "Determination of surface properties of various substrates using TiO_2 nanorod coatings with tuneable characteristics" *J. Mater. Sci.* **2008**, 43, 3474
4) M. Casavola, **R. Buonsanti**, G. Caputo, P. D. Cozzoli, "Colloidal strategies for preparing oxide-based hybrid nanocrystals", *Eur. J. Inorg. Chem.* **2008**, 6, 837-854
3) G. Caputo, **R. Buonsanti**, M. Casavola, P. D. Cozzoli "Synthetic strategies to multi-material hybrid nanocrystals", Advanced wet-chemical synthetic approaches to inorganic nanostructures, P. D. Cozzoli Ed.; Transworld Research Network, Kerala, India, **2008**, chapter 14 (pp. 407-453), ISBN 978-81-7895-361-8
2) **R. Buonsanti**, M. Casavola, G. Caputo, P. D. Cozzoli, "Advances in the chemical fabrication of complex multimaterial nanocrystals", *Recent Pat. Nanotechnol.* **2007**, 1 , 224-232
1) **R. Buonsanti**, V. Grillo, E. Carlino, C. Giannini, M. L. Curri, C. Innocenti, C. Sangregorio, K. Achterhold, F. G. Parak, A. Agostiano, P. D. Cozzoli, "Seeded Growth of Asymmetric Binary Nanocrystals Made of a Semiconductor TiO_2 Rodlike Section and a Magnetic γ-Fe_2O_3 Spherical Domain" *J. Am. Chem. Soc.* **2006**, 128, 16953 – 16970

PATENTS

PCT/US2012/051757 Nanostructured Transparent Conducting Oxide Electrochromic Device- Milliron, Delia J.; Tangirala, Ravisubhash; Llordes, Anna; Buonsanti, Raffaella; Garcia, Guillermo
PCT/US2012/047935 Electrochromic Nanocomposites Films- Milliron, Delia J.; Llordes, Anna; Buonsanti, Raffaella; Garcia, Guillermo
PCT/US2011/062036 Colloidal Infrared Reflective and Transparent Conductive Aluminum-Doped Zinc Oxide Nanocrystals Milliron, Delia J.; Buonsanti, Raffaella
IB-3124 Surface Chemical Modification of Nanocrystals-Brett A.; Milliron, Delia J.; Rosen, Evelyn L; Buonsanti, Raffaella; Llordes, Anna
IB-3216 Nanocrystal-polymer nanocomposite electrochromic device Milliron, Delia J.; Helms, Brett A.; Buonsanti, Raffaella; Garcia, Guillermo; Llordes, Anna; Runnerstrom, Evan L