BIOGRAPHICAL SKETCH

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NAME: **Roberto Guzmán**

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POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Guanajuato, Mexico	BS	1976	Chemical Engineering
University of Illinois, Chicago, Ill	MS	1980	Chemical Engineering
North Carolina State University, Raleigh, N.C	PhD	1988	Chemical Engineering
North Carolina State University, Raleigh, N.C	Posdoct	1988-89	Chemical Engineering

A. Personal Statement

The use of nanoparticles for controlled and targeted delivery of drugs and therapeutic proteins has been considered as a potential tool to eliminate the problems associated with the systemic administration of anticancer drugs that often results in harmful side effects that limit their efficacy. Their application will possibly eliminate the problems associated with the systemic administration of therapeutic proteins, which tend to rendered ineffective by protein degradation and excretion mechanisms, or by their nonspecific binding to cells and molecules other than their receptors. My research focus is in the development of multifunctional nanoparticles and biomolecular polymeric structures as medical molecular tools for diagnostics, imaging and therapy. Particularly, the engineering of delivery platforms and elucidation of mechanisms to enable controlled therapy and targeted co-delivery of encapsulated anticancer drugs and biomolecules such as insulin, insulin-like growth factor-1 (IGF-1) and cytokines. The experimental methodology to synthesize and engineer multifunctional nanoparticles of PLGA derivatives and a multilayer therapeutic hybrid patch for salivary glands function protection and restoration will be accomplished by following step wise synthetic processes. The functional PLGA nanoparticles loaded with the IGF-1 will provide an effective therapeutic strategy for the salivary glands function protection and restoration reaching higher and more effective levels of target delivery compared to the administration of the IGF-1 alone. I have developed theoretical and modeling experience and the background in synthesis of polymers and their functionalization with affinity ligands to carry out effective affinity ligand incorporation and biomolecule derivatives separations and analysis. We have the skills to modify different surfaces including polymers, polysaccharides, silicon oxides, gold and polymeric surfaces. The areas of research studied in my laboratory fall in the boundaries between synthetic chemistry, biology, medicine, polymer sciences and engineering and incorporate both experimental and theoretical work analysis.

1. G. Ramos-Clamont, M.C. Candia-Plata, **R. Guzmán** and L. Vázquez-Moreno (2006). "Novel Hydrophobic Interaction Chromatography Matrix for Specific Isolation and Simple Elution of Immunoglobulins (A, G, and M) From Porcine Serum." *Journal of Chromatography A*, 1122, 28-34. PMID: 16650852
2. P. Cortes, T. Zhu, G.B. Smith and **R. Guzmán** (2011). "Covalent coupling of polyacrylic acid coated magnetic-nanoparticles to multi-wall carbon nanotubes for manipulation targets." *Journal of Experimental Nanoscience*, Volume 6, Issue 6. Pages 665-678.
3. O. González-Ortega, J. Porath and **R. Guzmán** (2012). Adsorption of peptides and small proteins with control access polymer permeation to affinity binding sites. Part I. Polymer Permeation-IMAC separation adsorbents with polyethylene glycol and immobilized metal ions. *Journal of Chromatography A*, 1227, 115-125.

4. A. Lucero- Acuña, **R. Guzmán** (2015). "Nanoparticle encapsulation and controlled release of a hydrophobic kinase inhibitor: Three stage mathematical modeling and parametric analysis." *Int. J. Pharm*. 494, 249–257.

B. Positions and Honors

Professional Experience

1989 - 1996	Assistant Professor. Department of Chemical and Environmental Engineering, University of Arizona.
1995 - 1995	Visiting Scholar. Universite de Technologie de Compiegne, Laboratory of Molecular Interactions and Separations Technology, Compiegne, France. Summer 1995.
1999 - 1999	Visiting Scholar. University of Uppsala, Center for Surface Biotechnology and Separation Sciences, Uppsala. Summer 1999.
1996 – 2005	Associate Professor. Department of Chemical and Environmental Engineering, University of Arizona.
2005-present	Professor. Department of Chemical and Environmental Engineering, University of Arizona.
2014-Present	Visiting professor. Universite de Technologie de Compiègne, Laboratory of Cell and Enzyme Technology. Conduct research and teach a Master Course every year.

Honors

1983 - 1983	American States Organization Fellowship to conduct International research in the Summer of 1983 at Oregon State University, Corvallis.
1983 - 1988	International Fellowship from CONACYT, Mexico to conduct PhD studies
1989 - 1989	CONACYT Professorship Fellowship to conduct research and teaching in the summer of 1989 at University of Guanajuato. Mexico.
1995	International Fogarty Foundation Fellowship-Visiting Scholar -Summer of 1995 at Universite de Technologie of Compiegne, France.
1999	International Fogarty Foundation Fellowship-Visiting Scholar - Summer of 1999 at University of Uppsala, Sweden.
2014	Visiting professorship « Enseignant-Chercheur visiteur étranger», sponsored by the Marie Curie Initial Training network NANODRUG program in France.

C. Contributions to Science

1. Synthesis of multifunctional polymers for protein and surface interaction analysis

One of the main features of my research is based on the expertise I have obtained from working on synthesis of different structures and polymers and on their functionalization with affinity ligands to carry out effective affinity ligand incorporation and biomolecule derivatives for protein separations and analysis.

a. Ehteshami, G.R., Porath, J. and **Guzmán, R.** (1996). “Interactions and Applications of Soluble Heterobifunctional Affinity Chelating Polymers in Immobilized Metal Affinity Chromatography.” *J. Mol Recog*., vol 9., pp 733-737.
b. Ehteshami, G.R., Sharma, S.D., Porath, J. and **Guzmán, R.** (1997). “Synthesis of Monoprotected Derivatives of Homobifunctional Molecules.” *J. of Reactive Polymers*, 35, 135-143.
c. Chaga G., Porath J. and **Guzmán, R.** (1997) “A New Method to Synthesize Biopolymeric Affinity Ligands.” *Biotechnol. Appl. Biochem*. 26, 7-14.
d. Tejeda-Mansir, A.; Juvera, J.M.; Magana, I.; **Guzmán, R.** (1998). “Design of affinity membrane chromatographic columns.” *Bioprocess Eng*. 19, 2, 156-160.

2. Development of protein separation techniques

For more than 25 years we have synthesized different types of chromatographic matrices that have been used in the isolation and purification or proteins with new adsorbents for immobilized metal ion affinity chromatography, hydrophobic interaction chromatography and new adsorption permeation systems.

a. **Guzmán R,** Torres J.L., Carbonell R.G. and Kilpatrick P.K. (1989). "Water Soluble Non-Ionic Surfactants for Affinity Bioseparations." *Biotechnol. and Bioengineering,* 33, 1267.
b. G. Ramos-Clamont, M.C. Candia-Plata, **R. Guzmán** and L. Vázquez-Moreno (2006). "Novel Hydrophobic Interaction Chromatography Matrix for Specific Isolation and Simple Elution of Immunoglobulins (A, G, and M) From Porcine Serum." *J. of Chromatography A*, 1122, 28-34.
c. O. González-Ortega, J. Porath and **R. Guzmán** (2012). Adsorption of peptides and small proteins with control access polymer permeation to affinity binding sites. Part I. Polymer Permeation-IMAC separation adsorbents with polyethylene glycol and immobilized metal ions. *Journal of Chromatography A*, 1227, 115-125.
d. O. González-Ortega, J. Porath and **R. Guzmán** (2012). Adsorption of peptides and small proteins with control access polymer permeation to affinity binding sites. Part II: Polymer Permeation-Ion Exchange separation adsorbents with polyethylene glycol and strong anion exchange groups. *Journal of Chromatography A*, 1227, 126-137.

3. Development of plasmid separation technology

Based on the expertise that my laboratory has obtained through the years we have establised several robust methodologies to produce and purify DNA plasmids with the objective of incorporating such molecules in the development of DNA vaccines.

a. Montesinos-Cisneros, R.M., J. Ortega, **Guzmán R.** and Tejeda-Mansir A (2006). "Breakthrough performance of linear-DNA on ion-exchange membrane columns." Bioprocess Biosyst Eng. 29: 91–98. PMID: 16770595.
b. Guerrero-Germán P, Prazeres DM, **Guzmán R**, Montesinos-Cisneros RM, Tejeda-Mansir A, (2009) "Purification of plasmid DNA using tangential flow filtration and tandem anion-exchange membrane chromatography." *Bioprocess Biosyst Eng. Aug;32(5):615-23.*
c. Y. Pérez-Martínez , R. M. Montesinos-Cisneros , P. Guerrero-Germán, **R. Guzmán** & A. Tejeda-Mansir (2005). Batch Equilibrium and Kinetic Studies of Plasmid pCI Adsorption onto Perfusion Particles, J.Liquid Chromat & Related Technologies, 38:2, 196-200.
d. García-Rendón, A., Munguía-Soto, R., Montesinos-Cisneros, R.M., **Guzmán, R.,** & Tejeda-Mansir, A. (2017) "Performance analysis of exponential-fed perfusion cultures for pDNA vaccines production." J Chem Technol Biotechnol. Vol 92, Issue 2, 342–349.

4. Development of functionalized microchannels for capture of circulating cancer cells

The synthesis skills in my lab have been used to modify microchannels of silicon oxide surfaces for the development of sensing platforms for biosensors and for the capture of circulating cancer cells. This work together with our protein separation skills have been extended to the synthesis of platforms for detection of biomarkers for the development of liquid biopsies.

a. L-M. Lee, R. L. Heimark, **R. Guzmán**, J. C. Baygents and Y. Zohar (2006). "Low melting point agarose as a protection layer in photolithographic patterning of aligned binary proteins." Lab Chip. 6, 1080-1085.
b. Cheung LS, Zheng X, Stopa A, Baygents JC, **Guzmán R.**, Schroeder JA, Heimark RL, Zohar Y (2009). "Detachment of captured cancer cells under flow acceleration in a bio-functionalized microchannel." Lab Chip. 9(12):1721-31
c. L.S.L. Cheung, X.J. Zheng, , L. Wang, J. Schroeder, R.L. Heimark, J.C. Baygents, **R. Guzmán**, and Y. Zohar (2010). "Kinematics of Specifically Captured Circulating Tumor Cells in Bio-Functionalized Microchannels." J. Microelectromechanical Systems, VOL. 19, NO. 4.
d. Cheung LS, Zheng X, Baygents JC, Wang L, **Guzmán R**, Schroeder JA, Heimark RL, Zohar Y (2011). "Adhesion dynamics of circulating tumor cells under shear flow in a bio-functionalized microchannel." Journal of Micromechanics and Microengineering. 21, 054033.

5. Synthesis of theranostic systems with nanoparticles and encapsulated biomolecules

The synthesis and modeling skills in my laboratory have allow us to work successfully in the development of multifunctional nanoparticles and biomolecular polymeric structures as molecular tools for diagnostics, imaging and therapy. Particularly, the engineering of delivery platforms and elucidation of mechanisms to enable controlled therapy and targeted co-delivery of encapsulated anticancer drugs and biomolecules is rather promising.

a. Sarabia-Sainz, G. Ramos-Clamont, J. Lizardi-Mendoza, M.-P. Sanchez-Saavedra, M.C. Candia-Plata, A. Lucero-Acuna, **R. Z. Guzmán**, L. Vazquez-Moreno. Formulation and characterization of gentamicin-loaded albumin microspheres as a potential drug carrier for the treatment of E. coli K88 infections. Int. J. Drug Delivery, North America, Vol 4, No 2, Nov. 2012.
b. A. Lucero-Acuña, J.J. Jeffery, E. R. Abril, R. B. Nagle, **R. Guzmán**, M.D. Pagel, E. J. Meuillet (2014). "Nanoparticle delivery of an AKT/PDK1 inhibitor improves the therapeutic effect in pancreatic cancer." Int. J. of NanoMed. 9, 5653–5665.
c. Lucero- Acuña, **R. Guzmán** (2015). "Nanoparticle encapsulation and controlled release of a hydrophobic kinase inhibitor: Three stage mathematical modeling and parametric analysis." Int. J. Pharm. 494, 249–257.
d. Gutiérrez-Valenzuela, C.A., Guerrero-Germán, P., Tejeda-Mansir, A., Esquivel, R., **Guzmán-Z, R**., and Lucero-Acuña, A (2016). “Folate Functionalized PLGA Nanoparticles Loaded with Plasmid pVAX1-NH36: Mathematical Analysis of Release.” Appl. Sci. 2016, 6, 364.

D. Additional Information: Research Support and/or Scholastic Performance

Current

NSF Grant, R. Guzmán (PI) 06/01/16-05/31/19
Novel Polymer Adsorbents for Selective Peptide and Small Protein Separations from Blood for Discovery of Biomarkers.
The overall goal of this research is to develop specific adsorbents and surface platforms for small biomolecules enhanced selective binding. High-resolution biosensors could result that will identify unknown biomarkers from biological fluids.
Role: PI

TRIF-BIO5 Project- UA (R. Guzmán, Co-PI with K. Limesand as PI) 07/01/16-06/30/17
Utilization of Nanoparticles for Amelioration of Radiation-induced Salivary Gland Dysfunction.
The main goal of this work is to improve the translatability of a preclinical model of restoring function to irradiated salivary glands by utilizing nanoparticle drug targeting. One of the first objectives in this work is to optimize the encapsulation of IGF-1 in PLGA nanoparticles and characterize their release and effectiveness in salivary glands.
Role: Co-PI

TRIF-BIO5 Project- UA (R. Guzmán, Co-PI with J. Nikolich-Žugich as PI) 07/01/16-06/30/17.
Engineering Nanoparticles to Improve Immunity with Aging.
The aim of the proposal is to improve vaccination and immune fitness in older adults using functional nanoparticles. The goal is to engineer nanoparticles to deliver immunostimulatory cytokines and innate immune stimulators to aged T cells.
Role: Co-PI

USDA Grant, (R. Guzmán, Co-PI with R. Burd as PI) 10/01/14-09/30/17
Innovative approaches in nanotechnology. Nanotechnology 2020.
The main goal of this grant is to develop a learning platform that incorporates different aspects of nanoparticle and nanoscience technologies. The resulting teaching tool will be used to teach courses in nanosciencs that integrate both theoretical and experimental aspects. Active until 9-30-2018 as a no-cost extension.
Role: Co-PI

Completed

TRIF-BIO5 Project- University of Arizona, (R. Guzmán, Co-PI with L. Powers as PI) 02/01/12-01/31/13
Pathogen Diagnostics Based on Ligand Coated Active Nanoparticles.
The main objective of this work was to develop hybrid nanoparticles of silicon oxide, polymers and metals to enhance the signals when a target molecule binds to ligand-modified nanoparticles.
Role: Co-PI

Faculty Resources Grant, Cancer Center, (R. Guzmán, Co-PI with J. Daniel as PI) 09/06/10-09/05/11
University of Arizona
"Gold Nanoparticles Bioconjugates of Encapsulated Drugs for Targeted Combination Therapy of Lung Cancer":
Co-PI

Department of Defense, (R. Guzmán, Co-PI with Y. Zohar as PI) 09/01/07-08/31/10
BCRP Office of CDMRP
Innovative Microsystems: Novel Nanostructures to Capture Circulating Breast Cancer Cells.
The main objective of this research was the modification of silicon oxide microchannels with specific antibodies and test their feasibility to capture circulating cancer cells from biological fluids.
Role: Co-PI

NSF-NIRT, (R. Guzmán, Co-PI with P. Deymier as PI) 09/01/04-08/31/08
Reversible and Directional Self-Assembly of Bio-Molecular Templates for Nanotechnology Interconnects.
The main objective of this research was the modification of semiconductor (silicon oxide or gold) surfaces with antibodies and specific ligands. These surfaces could act as electrodes to growth under controlled conditions bound microtubules and connect them reversibly and directionally to adjacent or distant electrodes by self-assembly.
Role: Co-PI