BIOGRAPHICAL SKETCH

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NAME: BRINKER, C. JEFFREY

eRA COMMONS USER NAME (credential, e.g., agency login): cjbrink

POSITION TITLE: Distinguished Professor of Chemical and Biological Engineering and Molecular Genetics and Microbiology, UNM, Distinguished Affiliate Scientist SNL/LANL, Center for Integrated Nanotechnologies (CINT)

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

INSTITUTION AND LOCATION	DEGREE (if applicable)	START DATE MM/YYYY	END DATE MM/YYYY	FIELD OF STUDY
Rutgers University, New Brunswick, New Jersey	BS		06/1972	Ceramic Science
Rutgers University, New Brunswick, New Jersey	MS		12/1975	Ceramic Science
Rutgers University, New Brunswick, New Jersey	PhD		12/1978	Ceramic Science

A. Personal Statement

I pioneered so-called 'sol-gel processing' as a means of solution-based synthesis of a wide range of inorganic and composite nanostructured materials. During the past two decades, by combining sol-gel processing with molecular self-assembly, I have developed robust 'evaporation-induced self-assembly' and colloidal procedures (seven Science and Nature papers), enabling the facile synthesis of highly ordered porous and composite nanostructured films and particles. Nine years ago my team first reported the development of the 'protocell' – a mesoporous silica nanoparticle (MSN) loaded with drugs/imaging agents and encapsulated within a protective and biocompatible supported lipid bilayer (SLB) - as a universal, modular, nanocarrier platform for passive or active targeted delivery of multicomponent cargos to cancer (*see following patents and protocell publications). Active targeting has been accomplished by modification of the SLB with peptide, anti-bodies, scFvs, and ligands. Tissue penetrating targeted protocells were recently demonstrated by modification of the SLB with antibodies and protease nanocapsules. My combined appointments at UNM School of Engineering, the UNM Comprehensive Cancer Center, Sandia National Labs, and the Center for Integrated Nanotechnologies (CINT), a DOE Office of Science Nanoscale Science Research Center, provide a rich training environment and access to a vast array of nanofabrication and nano-characterization tools and platforms needed to establish structure-activity relationships of functional protocells and to optimize their in vivo performance as nanocarriers. In this project, I will direct the design, fabrication, and testing of folate-targeted protocells engineered to deliver synergistic drug combinations that will induce feed-forward loop of targeting cancer cells and disrupt ER protein homeostasis.

*Protocell Patents

1. Protocells and Their Use for Targeted Delivery of Multicomponent Cargos to Cancer Cells. Inventors: Brinker, C.J.; Ashley, C.E.; Jiang, X.M.; Liu, J.; Peabody, D.; Wharton, W.; Carnes, E.C.; Chackerian, B.; Wilman, C. US Patent 8,992,984 B1, Issued March 31, 2015.
2. Protocells and Their Use for Targeted Delivery of Multicomponent Cargos to Cancer Cells. Inventors: Brinker, C.J.; Ashley, C.E.; Jiang, X.M.; Liu, J.; Peabody, D.; Wharton, W.; Carnes, E.C.; Chackerian, B.; Wilman, C. US Patent 9,480,653 B2, Issued November 1, 2016.
3. Porous Nanoparticle Supported Lipid Bilayers (Protocells) For Targeted Delivery and Methods of Using Same. Inventors: Brinker, C.J.; Carnes, E.C Ashley, C.E.; Willman C.L. US Patent 9,579,283 B2, Issued February 28, 2017.
4. Porous Nanoparticle Supported Lipid Bilayer Nanostructures. Inventors: Liu, J.; Brinker, C.J.; Ashley, C.E.; Carnes, E.C. US Patent 8,743,816 B2, Issued May 27, 2014.

B. Positions and Honors

Positions and Employment

1979 - 1991	Member of the Technical Staff, Chemistry and Ceramics Department, Sandia National Laboratories (SNL), Albuquerque, NM
1991 - 1998	Distinguished Member of the Technical Staff, Direct Fabrication Department, Sandia National Laboratories (SNL), Albuquerque, NM
1991 - 1999	Distinguished National Laboratory Professor of Chemistry and Chemical and Nuclear Engineering, the University of New Mexico (UNM), Albuquerque, NM
1999 - 2003	Senior Scientist, Chemical Synthesis and Nanomaterials Department, Sandia National Laboratories (SNL), Albuquerque, NM
1999 - 2006	Professor of Chemistry and Chemical & Biological Engineering, The University of New Mexico (UNM), Albuquerque, NM
2003	Sandia Fellow (one of 2 Lab-Wide) Center for Self-Assembled Materials, Sandia National Laboratories (SNL), Albuquerque, NM
2006 - Present	Distinguished Affiliate Scientist SNL/LANL, Center for Integrated Nanotechnologies (CINT)
2006 - 2008	Regent's Professor of Chemical & Biological Engineering; Molecular Genetics and Microbiology, University of New Mexico, Albuquerque, NM
2008 - Present	Distinguished Professor of Chemical and Biological Engineering and Molecular Genetics and Microbiology, University of New Mexico, Albuquerque, NM
2010 - Present	Member, UNM Comprehensive Cancer Center, Albuquerque, NM

Other Experience and Professional Memberships

1988	Fellow, American Ceramic Society
2002	Member, National Academy of Engineering of the United States of America
2009	Fellow, The Materials Research Society
2012	Member, Médaille du Collège de France
2014-2017	Board of Directors, Materials Research Society
2015	Member, National Academy of Inventors
2018	Member, American Academy of Arts and Sciences

Honors (partial list)

1988	Zachariasen Award for best contribution to the glass science literature 1985-1987, The Journal of Non-Crystalline Solids
1996	R&D100 Award - Low Temperature/Pressure Process to Produce Aerogels, R&D Magazine
1996	American Chemical Society Iler Award, Chemistry of Colloidal Materials
2001	National Collegiate Inventors Competition Award, Optically-Adjustable Nanostructures
2002	DOE Ernest O. Lawrence Memorial Award in Materials Science, U.S. Department of Energy
2003	Materials Research Society MRS Medal, Materials Research Society
2005	Research Excellence Award, The University of New Mexico
2006	Distinguished Alumnus Award, Rutgers University
2007	R&D100 Award - Self-Assembly of Nanoparticle Films, R&D Magazine
2008	Edward R. Orton Jr. Memorial Award, American Ceramic Society and ASM
2008	R&D100 Award - Patterned Superhydrophobic Surfaces, R&D Magazine
2010	Robert B. Sosman Award, American Ceramics Society
2011	R&D100 Award - Biomimetic Water Purification Membranes, R&D Magazine
2012	Notable Technology Development Award – Biomimetic Membranes, Federal Laboratory Consortium
2013	Outstanding Regional Partnership – UNM Health Sciences Center/Sandia National Laboratories Partnership, Federal Laboratory Consortium
2014	Notable Technology Development Award, Nano-Stabilized Enzymatic Membrane for CO2 Capture, Federal Laboratory Consortium
2015	Named Innovation Fellow, Science and Technology Corporation/University of New Mexico
2015	UNM Presidential Medal of Distinction, The University of New Mexico

2015	R&D100 Award – CO2 Memzyme, R&D Magazine
2015	R&D 100's 'Green Technology Special Recognition Gold Award' for CO2 Memzyme, R&D Magazine
2017	Life Time Achievement Award in Sol-Gel Science and Technology

Present membership on Federal Government public advisory committees, DOE/BES Materials Sciences and Engineering Division Committee on Basic Research Needs in Materials Processing, EAB NSF NanoBio Node

C. Contribution to Science (Total Citations >50,000, h index = 91, Google Scholar™)

1. Development of evaporation-induced self-assembly (EISA) of controlled nanostructures - In 1997, Dr. Brinker's group published their pioneering work on evaporation induced self-assembly (EISA) of ordered 'mesoporous' silica films (pore size 2-30-nm). This research was the first to combine controlled sol-gel chemistry (formation of inorganic materials from soluble molecular precursors) with molecular self-assembly, enabling rapid, continuous processing and precise structural control of self-assembled nanoscale films used throughout the world in lab-on-a-chip technologies and biosensors. (In 2006 ISI recognized this paper as a top 20 materials science paper of the prior decade). EISA is now practiced throughout the world and has been extended to a wide spectrum of oxide materials. Importantly in 1999 Brinker extended EISA to demonstrate for the first time the formation of controlled mesoporous silica nanoparticles (MSN). MSN are being extensively studied throughout the world for the delivery of drugs, diagnostics and combined cargos. MSN are the basis of the protocell drug delivery platform described below.

    a. Chen Z, Jiang Y, Dunphy DR, Adams DP, Hodges C, Liu N, Zhang N, Xomeritakis G, Jin X, Aluru NR, Gaik SJ, Hillhouse HW, Brinker CJ. DNA translocation through an array of kinked nanopores. Nat Mater. 2010 Aug;9(8):667-75. PubMed PMID: 20651807.
    b. Fan H, Lu Y, Stump A, Reed ST, Baer T, Schunk R, Perez-Luna V V, Lopez GP, Brinker CJ. Rapid prototyping of patterned functional nanostructures. Nature. 2000 May 4;405(6782):56-60. PubMed PMID: 10811215.
    c. Lu, YF, Ganguli R, Drewien CA, Anderson MT, Brinker CJ, Gong WL, Guo YX, Soyez H, Dunn B, Huang MH, Zink JI. Continuous formation of supported cubic and hexagonal mesoporous films by sol gel dip-coating. Nature. 1997 Sept 25; 389(6649):364-68. No PMID.
    d. Lu, YF, Fan HY, Stump A, Ward TL, Rieker T, Brinker CJ. Aerosol-assisted self-assembly of mesostructured spherical nanoparticles. Nature. 1999 Mar 18; 398(6724):223-6. No PMID.

2. Development of controlled bio-nano interfaces - In a 2006 Science article, we reported on using living cells to direct the formation of novel nano/bio interfaces maintaining cell viability under extreme conditions and serving to differentiate cellular behavior by virtue of 3D-nanoconfinement and its consequences on physical and chemical cues translated to encapsulated cells. Of particular note is that 3D confinement of individual *S. aureus* induced quorum sensing and genetic reprogramming to a pathogenic state. 3D cellular encapsulation is important for new classes of biosensors and 'living' materials. Additionally, 3D cellular encapsulation promises to provide a useful platform to perform microbial experiments at the scale of the microbes themselves and thus to investigate and understand biology at the level of the individual organism (a dream of contemporary environmental microbiologists).

    a. Baca HK, Ashley C, Carnes E, Lopez D, Flemming J, Dunphy D, Singh S, Chen Z, Liu N, Fan H, López GP, Brozik SM, Werner-Washburne M, Brinker CJ. Cell-directed assembly of lipid-silica nanostructures providing extended cell viability. Science. 2006 Jul 21;313(5785):337-41. PubMed PMID: 16857936.
    b. Kaehr B, Townson JL, Kalinich RM, Awad YH, Swartzentruber BS, Dunphy DR, Brinker CJ. Cellular complexity captured in durable silica biocomposites. Proc Natl Acad Sci U S A. 2012 Oct 23;109(43):17336-41. PubMed PMID: 23045634; PubMed Central PMCID: PMC3491527.
    c. Carnes EC, Lopez DM, Donegan NP, Cheung A, Gresham H, Timmins GS, Brinker CJ. Confinement-induced quorum sensing of individual Staphylococcus aureus bacteria. Nat Chem Biol. 2010 Jan;6(1):41-5. PubMed PMID: 19935660; PubMed Central PMCID: PMC4201857.

d. Sellinger, A, Weiss PM, Nguyen A, Lu YF, Assink RA, Gong WL, Brinker CJ. Continuous self-assembly of organic-inorganic nanocomposite coatings that mimic nacre. Nature. 1998 Jul 16;394(6690):256-260. No PMID.

3. Development of protocells - In 2009, we reported the formation of a revolutionary new class of nanocarriers for treatment of cancer and rare and infectious disease. The nanocarrier – termed a protocell – consists of a high surface area (>1000 m2/g) mesoporous silica nanoparticle core, loaded with drugs, and encapsulated within a cell membrane-like supported lipid bilayer. This protocell construct synergistically combines the properties of nanoporous particle and liposomal delivery agents to simultaneously address multiple challenges associated with drug delivery to cancer. It allows the packaging and protection of multiple types of cargos via encapsulation within the supported lipid bilayer. Upon acidification of the protocell within an endosomal environment, the lipid bilayer is destabilized enabling triggered drug release.

   a. Liu J, Jiang X, Ashley C, Brinker CJ. Electrostatically mediated liposome fusion and lipid exchange with a nanoparticle-supported bilayer for control of surface charge, drug containment, and delivery. J Am Chem Soc. 2009 Jun 10;131(22):7567-9. PubMed PMID: 19445508; PubMed Central PMCID: PMC2724844.
   b. Tarn D, Ashley CE, Xue M, Carnes EC, Zink JI, Brinker CJ. Mesoporous silica nanoparticle nanocarriers: biofunctionality and biocompatibility. Acc Chem Res. 2013 Mar 19;46(3):792-801. PubMed PMID: 23387478; PubMed Central PMCID: PMC3686852.
   c. Liu J, Stace-Naughton A, Jiang X, Brinker CJ. Porous nanoparticle supported lipid bilayers (protocells) as delivery vehicles. J Am Chem Soc. 2009 Feb 4;131(4):1354-5. PubMed PMID: 19173660; PubMed Central PMCID: PMC2649781.
   d. Liu J, Stace-Naughton A, Brinker CJ. Silica nanoparticle supported lipid bilayers for gene delivery. Chem Commun (Camb). 2009 Sep 14;PubMed PMID: 20448959; PubMed Central PMCID: PMC2867086.

4. Development and performance of targeted protocells - Protocells, when modified with a targeting peptide that binds to human liver cancer (hepatocellular carcinoma, or HCC), exhibit a >1000x affinity for HCC than for normal human hepatocytes, endothelial cells, and immune cells. Due to the enormous cargo capacity of the high-surface-area nanoporous silica core, combined with the enhanced targeting efficacy enabled by the supported lipid bilayer's remarkable fluidity, as few as one protocell loaded with a chemotherapeutic drug cocktail can kill an HCC cell having induced multiple drug resistance. Targeted protocells can deliver cargo to individual circulating leukemia cells and, when further modified with protease nanoparticles, can pentrate extra cellular matrix tissue. The protocell technology promises to revolutionize the field of targeted drug delivery. It is the basis of 4 issued patents and 47 patent applications being prosecuted throughout the world.

   a. Epler K, Padilla D, Phillips G, Crowder P, Castillo R, Wilkinson D, Wilkinson B, Burgard C, Kalinich R, Townson J, Chackerian B, Willman C, Peabody D, Wharton W, Brinker CJ, Ashley C, Carnes E. Delivery of ricin toxin a-chain by peptide-targeted mesoporous silica nanoparticle-supported lipid bilayers. Adv Healthcare Mater. 2012 May;1(3):348-53. PubMed PMID: 23184753; PubMed Central PMCID: PMC4119887.
   b. Ashley CE, Carnes EC, Epler KE, Padilla DP, Phillips GK, Castillo RE, Wilkinson DC, Wilkinson BS, Burgard CA, Kalinich RM, Townson JL, Chackerian B, Willman CL, Peabody DS, Wharton W, Brinker CJ. Delivery of small interfering RNA by peptide-targeted mesoporous silica nanoparticle-supported lipid bilayers. ACS Nano. 2012 Mar 27;6(3):2174-88. PubMed PMID: 22309035; PubMed Central PMCID: PMC3332089.
   c. Ashley CE, Carnes EC, Phillips GK, Padilla D, Durfee PN, Brown PA, Hanna TN, Liu J, Phillips B, Carter MB, Carroll NJ, Jiang X, Dunphy DR, Willman CL, Petsev DN, Evans DG, Parikh AN, Chackerian B, Wharton W, Peabody DS, Brinker CJ. The targeted delivery of multicomponent cargos to cancer cells by nanoporous particle-supported lipid bilayers. Nat Mater. 2011 May;10(5):389-97. PubMed PMID: 21499315; PubMed Central PMCID: PMC3287066.
   d. Durfee, PN, Lin, YS, Dunphy, DR, Muniz, AJ, Butler, KS, Humphrey, KR, Lokke, AJ, Agola, JO, Chou, SS, Chen, IM, Wharton, W, Townson, JL, Willman, CL, Brinker, CJ. Mesoporous Silica Nanoparticle-

Supported Lipid Bilayers (Protocells) for Active Targeting and Delivery to Individual Leukemia Cells. ACS Nano. 2016 Sept;10(3):8325-45. PMID:_PubMed Central PMCID: _

Complete List of Published Work in My Bibliography:
https://www.ncbi.nlm.nih.gov/myncbi/1NoQrU5pQlVAh/bibliography/40227296/public/

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

Ongoing Research Support

LLS 7010-14 SCOR Carroll/NYU (PI) 10/1/2013 – 9/30/2018
Developing Novel Therapies for Pediatric and Young Adult ALL
Silica nanoparticles have recently received FDA approval for targeted molecular imaging in cancer; these studies will lay the foundation for FDA-reviewed IND-directed toxicology studies.
Role:Co-PI

0830117 Nel/UCLA (PI) 9/1/2009 – 8/31/2018
Center for Environmental Implications of Nanotechnology (CEIN) Systematic Synthesis of Nanoparticles
The goal of this project is to develop a broad-based model of predictive toxicology premised on the quantitative structure-activity relationships and nanomaterial injury mechanisms at the biological level.
Role: UNM PI

NSF 13-518 INSPIRE Y. Wang/UCSD (PI) 9/1/2013 – 8/31/2018
Protocells as a Platform for Bottom-up Synthetic Biology
We will develop a proof-of-concept bottom-up cell utilizing the protocell - a single cell entity that will serve as a nanoscale machine capable of perceiving external environmental cues and guiding the regulation of signaling transduction and gene/protein production inside the cells.
Role: UNM PI

1685567 Brinker/SNL (PI) 5/11/2016 – 9/30/2018
Modular Abiotic/Biotic Systems (MABS)
This project aims to discover and explore novel classes of Modular Abiotic/Biotic Systems invented/pioneered by our team including synthetic biological cells, nanoparticle decorated/modified organisms, and tunneling nanotubes
Role: PI

1714007 Brinker/SNL (PI) 8/5/2016 – 9/30/2018
NanoCRISPR Fabrication and Imaging
This project aims to develop a nanoparticle platform technology for delivering CRISPR gene editing components to target cells and tissues
Role: PI

NSF 12-269 REU Site Datye/UNM (PI) 4/15/2013 – 3/31/2018
REU Site: Research Experience for Undergraduates in NSMS
Brinker will serve to mentor two undergraduate students in engineered bio/nano systems
Role: Co-PI