

## CV-BIOGRAPHICAL SKETCH Nov 2014

CHARLES LINDER PhD

Research Professor Emeritus at Ben Gurion University of the Negev

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### A) Education

Brooklyn College MSc 1965-1967 Organic chemistry

Polytechnic Institute of Brooklyn PhD 1967-1972 Polymers, Macromolecules and physical chemistry

### B) Positions and Honors.

-Ben-Gurion University: 1998-present Research Professor Supramolecular chem., nanovesicles, membr.

-Membrane Products Kiryat Weizmann: 1976-1998 R&D Manager-Membrane developments, drug delivery

-Hoffman LaRoche 1972-1976 Senior Scientist Drug Delivery

-Award: The Weizmann Institute of Science: H. Dudley Wright Achievement Prize "For Contribution of Membrane Research to the Greater Good of Mankind"

### C) Research Grants and projects of the last 10 years

1-Recycling Chemicals, Energy and Water Aggressive Waste Water Streams with Novel Modified Nanofiltration (NF) Membranes: from European Consortium project ( RENOMEN) 2001-2004

2-Hydrogen-bonding interactions between vesicle forming amphiphiles and vesicle stability: US-Israel Binational Science Foundation 2004-2008

3-Tissue-targeted smart surfaced nano-size vesicles: Yeshayahu Horowitz Applied Research Fund 2002-2004

4-Oral delivery of opioid peptides by novel nano-size vesicles: Israel Ministry of Trade Commerce and Labor 2007-2008

5-Development of novel systems for water purification: European Consortium 2009-2011

6-BBB permeability of bola vesicles: Israel Science Foundation 2011-present

7-Targeted Delivery of GDNF to Brain: The Michael J. Fox Foundation 2011-2012

8-Targeted Delivery of GDNF to Brain: The Michael J. Fox Foundation 2013-2014

9-Delivery of Tenofovir to the Brain: The Campbell Foundation 2012- 2013

10-Targeted Delivery of GDNF to Brain Motoneurons: The ALS Association 2014-present

## D) Publications

1. Stern A, Guidotti M, Shaubi E, Popov M, Linder C, Heldman E, Grinberg S, Steric environment around acetylcholine head groups of bolaamphiphilic nanovesicles influences the release rate of encapsulated compounds. *Int. J. NanoMed* January 2014 **Volume** 2014:9(1) **Pages** 561 – 574
2. Yang, C., Li, X.-M., Gilron, J., Kong, D.-F., Yin, Y., Oren, Y., Linder, C., He, T. CF plasma-modified superhydrophobic PVDF membranes for direct contact membrane distillation *Journal of Membrane Science* volume 456, issue , year 2014, pp. 155 – 161
3. Y.Kaufman, S.Grinberg, C.Linder, E.Heldman, J. Gilron , Yue-xiao Shen , M.Kumar , V.Freger., "Supported Bolaamphiphile Membranes for Water Filtration: Role of Lipid-Support Interactions" *J Membrane Science* Volume 457, 1 May 2014, Pages 50–61
4. Bhekani S. Mbuli<sup>1</sup>, Edward N. Nxumalo<sup>1</sup>, Sabelo D. Mhlanga<sup>1</sup>, Rui W. Krause<sup>1</sup>, Visvanathan L. Pillay<sup>2</sup>, Yoram Oren<sup>3</sup>, Charles Linder<sup>3</sup> and Bhekie B. Mamba Development of antifouling polyamide thin-film composite membranes modified with amino-cyclodextrins and diethylamino-cyclodextrins for water treatment, *Journal of Applied Polymer Science*, Volume 131, Issue 8, April 15, 2014
5. Philosof-Mazor L, Dakwar GR, Popov M, Kolusheva S, Shames A, Linder C, Greenberg S, Heldman E, Stepensky D, Jelinek R. (2013) Bolaamphiphilic vesicles encapsulating iron oxide nanoparticles: New vehicles for magnetically targeted drug delivery. *Int J Pharm.* Apr 24;450(1-2):241-249.
6. Popov M, Abu Hammad I, Bachar T, Grinberg S, Linder C, Stepensky D, Heldman E. Delivery of analgesic peptides to the brain by nano-sized bolaamphiphilic vesicles made of monolayer membranes. *Eur J Pharm Biopharm.* 2013 Jun 18. [Epub ahead of print]
7. Kim T, Afonin K, Viard M, Koyfman A, Sparks S, Heldman E, Grinberg S, Linder C, Blumenthal R and Shapiro B (2013) *In silico*, *in vitro* and *in vivo* studies indicate the potential use of bolaamphiphiles for therapeutic siRNA delivery, *Nature Therap Nuc Acids* March; 2(3): e80
8. Kaufman Y, Grinberg S, Linder C, Heldman E, Gilron J, Freger V. (2013) Fusion of bolaamphiphile micelles: a method to prepare stable supported biomimetic membranes. *Langmuir.* 29(4):1152-1161.
9. Bhekani S. Mbuli, Edward N. Nxumalo, Rui W. Krause, Visvanathan L. Pillay, Yoram Oren, Charles Linder, Bhekie B. Mamba, Modification of polyamide thin-film composite membranes with amino-cyclodextrins and diethylamino-cyclodextrins for water desalination, *Separation and purification technology* **Volume 120**, 13 December 2013, Pages 328–340
10. Bhekani , Linder, Oren et al "Preparation and Characterization of Thin Film Composite Membranes modified with amine functionalized Cyclodextrins, *Journal of Applied Polymer Science* - Manuscript # APP-2012-04-1378 has been accepted Oct 2012

11. T. Hutter, C. Linder, E. Heldman, and S. Grinberg Interfacial and self-assembly properties of bolaamphiphilic compounds derived from a multifunctional oil, *Journal of Colloid and Interface Science*, 365( 1), p 53-62, 2012.
12. M. Popov, S. Grinberg, C. Linder, Z. Bachar, T. Waner, R. Deckelbaum and E. Heldman Site- directed decapsulation of bolaamphiphilic vesicles with enzymatic cleavable surface groups *Journal of Controlled Release* 160 (2), 306-314 9( 2012)
13. Dakar, G., Abu Hammad I, Popov M, Linder C, Grinberg S, Heldman E, Stepensky D Delivery of proteins to the brain by bolaamphiphile nano-sized vesicles. *Journal of Controlled Release* 160, 315-321 ( 2012)
14. Popov M., Linder C., Deckelbaum R.J., Grinberg S., Hansen I.H., Shaubi E., Waner T., Heldman E. Cationic vesicles from novel bolaamphiphilic compounds. *J Liposome Res*;20(2):147-59 2010
15. Grinberg S., Kipnis N., Linder C., Kolot V. and Heldman E. (2010) Asymmetric bolaamphiphiles from vernonia oil designed for drug delivery. *Eur. J. Lipid Sci. Technol.* 112: 137–151
16. Grinberg S, Kolot V, Linder C, Shaubi E, Kas'yanov V, Deckelbaum RJ, Heldman E. Synthesis of novel cationic bolaamphiphiles from vernonia oil and their aggregated structures. *Chem Phys Lipids*. 2008 Feb 12
17. Shapiro, V. Freger, C. Linder and Y. Oren. "Transport Properties of Highly Ordered Heterogeneous Ion-Exchange Membranes" *V. J. Phys. Chem. B*, **2008**, 112 (31), pp 9389-9399
18. Gloukhovski, R., Oren, Y., Linder, C., Freger, V., "Thin Film composite nanofiltration membranes prepared by electropolymerization, *J. Applied Electrochem.* (2008) 38: 759-766
19. Wiesman Z, Dom NB, Sharvit E, Grinberg S, Linder C, Heldman E, Zaccai M. Novel cationic vesicle platform derived from vernonia oil for efficient delivery of DNA through plant cuticle membranes. *J Biotechnol.* 2007 May 31;130(1):85-94.
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21. Markus, A. and Linder, C. 2006. Advances in the technology of controlled release pesticide formulations. In: S. Benita (Ed.) *Microencapsulation: Methods and Industrial Applications*. Taylor & Francis
22. Linder, C., Oren, Y, Kedem O., "Relationship between Material parameters of Nanofiltration membranes and Membrane performance", *J Desalination*, 199 (1-3); 256, 2006
23. S. Grinberg, C. Linder, V. Kolot, T. Waner, Z. Wiesman, E. Shaubi, and E. Heldman "Novel Cationic Amphiphilic Derivatives from Vernonia Oil: Synthesis and Self-Aggregation into Bilayer Vesicles, Nanoparticles, and DNA Complexants" *Langmuir*; 2005; 21(17) pp 7638 - 7645;
24. Oren, Y., Freger, V. and Linder, C., 2004: Highly ordered heterogeneous ion exchange membranes. *Journal of Membrane Science* 239(1), 17-26. (2004)

25. Y. Oren, I. Rubinstein, C. Linder, G. Saveliev, B. Saltzman, E. Mirsky, O Kedem, "Modified Heterogenous Anion Exchange Membranes for Desalination of Brackish and Recycled Water" *Environmental Engineering Science*, 19(6), 512 (2003)
26. I. Rubinstein, B. Zaltzman, J. Peretz and C Linder, "Experimental verification of the electro-osmotic mechanism of overlimiting conductance through a cation exchange membrane" *Journal of Russian Electrochemistry (Translation of Elektrokimiya)*, 38(8) 653-863, 2002.
27. C. Linder and Ora Kedem " Asymmetric ion exchange mosaic membranes with unique selectivity" *Journal of Membrane Science* 181 (2001) 39-56
28. R. Rautenbach, R. Knauf und C. Linder, *Maschinemarkt, Wurzburg*, 100 (1994) 43, 16-21 "Fraktioniert trennen. Erweiterte Anwendungsmöglichkeiten des Verfahrens der Nanofiltration".
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30. M. Perry and C. Linder, *Desalination*, 71, 233-245, (1989). "Intermediate Reverse Osmosis Ultrafiltration Membranes for the Concentrations And Desalting of Low molecular weight organic Species".
31. C. Linder and G. Ziv, *Journal Vet. Pharmacological Therapeutics* 6, 33-40, (1983). "Encapsulated Forms of Slow Release Dry Cow Products of Rapidly Absorbed Antibiotics".
32. C. Linder and J. Fishman, *Journal of Medicinal Chemistry*, 16, 553-556, (1973) "Narcotic Antagonists I-Isomeric Sulfate and Acetate Esters of Naloxone (N-allylnoroxymorphone".
33. C. Linder, I. Miller, *Journal of Polymer Science, Polymer Chemical Edition*, Vol 11, 1119-1130 (1973). "The Effect of Tacticity and Morphology on the Formation and Stabilization of Persistent Electrical Polarization in Polar Polymer Membranes".
34. C. Linder and I Miller , *Journal of Physical Chemistry*, 76, pp 3434-3445, (1972), "Persistent Electrical Polarization in Polyelectrolyte Membranes".
35. C. Linder and I. Miller , *Journal of the Electrochemical Society*, 120, No. 4, 498-503, (1973), "The Coexistence of Persistent Electrical Polarization and Electrical Conductivity in Polyelectrolyte Membranes".
36. N. Indictor, C. Linder, *Journal of Polymer Science, Pt. A-1*, 5, 1101 (1967) "Styrene Polymerisation via Hydroperoxide-Metalacetylacetonate Catalysts".

37. N. Indictor, C. Linder, Journal of Polymer Science. Pt. A3(10), 3668 (1965) "Olefinic-Hydroxide-Metal Acetylacetonate Interactions."

### Patents

- 1) Zabicky J, Linder C, Grinberg S, Heldman E: Nano- and mesosized particles comprising an inorganic core, process and applications thereof. US 8,377,469 Issued February 19 2013
- 2) Y. Oren, O. Kedem, S. Freger, C. Linder, E. Cohen, PCT patent application July 4, 2003 filed by BG Negev "Highly Conductive Ordered Ion Exchange Membranes". US patent 7,887,967 June 22, 2010
- 3) E. Heldman, C. Linder, S. Grinberg Amphiphilic compounds and vesicles liposomes for organ-specified drug targeting" US patent 7887,833 Feb 15 2011
- 4) S. Grinberg, C. Linder, E. Heldman, Z. Weizman, and V. Kolot US patent **7,939,562** "Amphiphilic Derivatives for the Production of Vesicles, Micelles, Complexants, and Uses Thereoff" May 10 2011
- 5) S. Belfer, Y. Purinson, R. Fainstein, L. Kesselman, C. Linder. " Process for improving membranes US patent 7,677,398 March 16, 2010
- 6) C. Linder, O. Kedem, Y. Oren "Membranes, Coatings and films" PCT application P-9447-PC ( Dec 2007)
- 7) Arie MARKUS, Charles LINDER and Pnina STRONGIN Encapsulated Essential Oils - (IC0047333) WO 2004/098767 Accepted as a US and European patent.
- 8) Arie MARKUS, David SCHUSTER, Charles LINDER and Pnina STRONGIN Formulations Containing Microencapsulated Essential Oils - (IC0045214) US patent application 11/040,102 24/JAN/2005 Accepted as a US patent
- 9) N. A. Fleischer, J. Manassen, C. Linder, N. Mazor, A. Meitav, I. Yakupov, United States Patent Application, 20020127474, September 12, 2002, "Proton-selective conducting membranes" + WO02058205 - 2002-07-25
- 10) C. Linder, M. Nemas, and R. Katrarro, US 6086764( 2001) + world wide patents "Semipermeable encapsulated membranes with improved acid and base stability: process for their manufacture and their use".
- 11) R. Katrarro, C. Linder, M. Nemas, US 6077376 (2001) + world wide patents " Process for Producing a Tubular Membrane Assembly".
- 12) C. Linder, M. Nemas, M. Perry, R. Katrarro, US Patent 5,430,099, July 4, 1996 + world wide patents, "Immobilized Buffered Gels and Membranes of Hydroxy Groups Containing Polymers".
- 13) C. Linder, M. Nemas, M. Perry, R. Katrarro, US patent 5,597,863, Jan 28, 1997, "Immobilized Buffered Gels and Membranes of Hydroxy Groups Containing Polymers".
- 14) C. Linder, M. Nemas, M. Perry, R. Katrarro, US patent 5,599,506, Feb 4, 1997, "Immobilized Buffered Gels and Membranes of Hydroxy Groups Containing Polymers".

- 15) R. Katraró, C. Linder, M. Nemas, Israel Patent application 115,941, Nov 16, 1995, and worldwide patents "Multistage Membrane System and Process".
- 16) C. Linder, M Nemas, M. Perry, R. Katraró, US patent 5,265,735 Nov 30, 1993. "Silicone Derived Solvent Stable Membranes" + world wide patents
- 17) J. Yacubowicz, M. Perry, R. Katraró, C. Linder, W. Grossmann, "Separation and Recovery of Compounds dissolved in a liquid such as water", Ger Offen, DE 4,236,713A.
- 18) C. Linder, M. Nemas, M. Perry, R. Katraró US patent 5,049,282 Sept 17, 1991 "Semi permeable Composite Membranes" + world wide patents
- 19) C. Linder, M. Nemas, M. Perry, R. Katraró, US patent 5, 039,421, Aug 13, 1991, "Solvent Stable Membranes" + world wide patents
- 20) C. Linder, M. Nemas, M. Perry, R. Katraró, US patent 5, 032, 282, July 16, 1991, "Solvent Stable Semi permeable Composite Membranes" + world wide patents
- 21) C. Linder, M. Nemas, M. Perry, R. Katraró, US patent 5,028,337, July 2, 1991 "Coated Membranes"
- 22) C. Linder M. Nemas M. Perry, R. Katraró, US patent 5,024,765 June 18, 1991. "Composite Membranes and Processes for Using Them"
- 23) M. Perry, H. Yacubowicz, C. Linder, M.Nemas, R. Katraró, US patent 5,151,182 September 29, 1992, "Polyphenylene Oxide- Derived Membranes for Separations in Organic Solvents."
- 24) C. Linder, M. Perry, M. Nemas, European patent application, 0 476 875 A2, 30/8/91. "Process for the purification and concentration of biologically active materials."
- 25) C. Linder and M. Nemas, M Perry, R. Katraró, European Patent Application 0489693 A1, 29/11/91 "Charged Asymmetric Mosaic Membranes" + US patent
- 26) C. Linder and M. Nemas, M. Perry and R, Katraró, Patent Application GB-A-2233248, June 7, 1989, "Enantiomer Enrichment by Membrane Processes".
- 27) C. Linder, G. Aviv, M. Perry and R. Katraró, US patent 4, 833,014, and 1989. "Composite amphoteric membranes useful for the separation of organic compounds of low molecular weight solutes from inorganic salt streams"
- 28) C. Linder, G. Aviv, M. Perry and R. Katraró, US patent 4,767,645 August 30, 1988. "Composite amphoteric membranes useful for the separation of organic compounds of low molecular weight solutes from inorganic salt streams." + worldwide patents.
- 29) C. Linder, G. Aviv, M. Perry and K. Katraró, US patent 4,778,596, Oct. 18, 1988, "Semi permeable Encapsulated Membranes- Their Manufacture and Use". + World wide patents
- 30) M. Perry, R. Katraró, C. Linder, Patent Application EP 90810419.3 1989 "Process and Apparatus for the removal of undesired components from aqueous feed stocks"
- 31) C. Linder, G. Aviv, M. Perry, R. Katraró, US patent 4,690, 765, Sept.1, 1988, "Chemically Modified Semi permeable polysulfone membranes and their use in reverse osmosis and ultrafiltration" + world wide patents
- 32) C. Linder and M. Perry US patent 4 911 844 (1989), Semi permeable composite membranes and their manufacture and use, + World wide patents

- 33) C. Linder, M. Perry, R. Katraró, US patent 4,761,233, Aug 21, 1988. Novel Membranes and Process for making them.+World wide patents
- 34) C. Linder, M. Perry, M.Nemas, R. Katraró, Is Patent Application No. 8434, 1988 "Ion Transport Selective Membranes"
- 35) C. Linder, G. Aviv, M. Perry, R. Katraró, US patent 4,690,766, Sept 1, 1987, "Chemically Modified Semi permeable polysulfone membranes and their use in reverse osmosis and ultrafiltration" + world wide patents.
- 36) C. Linder, G. Aviv, M. Perry, R. Katraró, US patent 4 720, 345, January 19, 1988 "Semi permeable membranes of Modified polystyrene for Reverse Osmosis and Ultrafiltration, Their Use and Manufacture"
- 37) C. Linder, and M. Perry, US patent 4,604,204, Aug. 5, 1986. "Porous Semi permeable Membranes of Chemically Modified Cellulose Acetate"
- 38) C. Linder, and M. Perry US patent 4,584,103, Apr. 22, 1986. "Reverse Osmosis or Ultrafiltration Modified Polyacrylonitrile Membranes" + world wide patents.
- 39) C. Linder, G. Aviv, M. Perry and R. Katraró, US patent 4 477634, October 16, 1984. "Modified Acrylonitrile Polymer Containing Semipermeable Membranes".
- 40) M. Perry, R. Katraró , C. Linder, G. Aviv, US patent 4,659, 474. "Dynamically Formed Membranes"+ world wide patents.
- 41) M. Perry, J. Gilron, R. Katraró and C. Linder, European application 369445, 1989. Process and device for the separating electrically charged macromolecular compounds by Forced Flow Membrane Electrophoresis.
- 42) C. Linder, G. Aviv, US patent 4,413,999, Nov. 8, 1983. "Amidoxime Derivatives. Process for their Preparation and Application". A new class of Chemical Reaction Products for Material modification and biologically reactive compounds. + world wide patents.
- 43) M. Perry, C. Linder, O. Kedem, US patent 4,246,092, January 20, 1981. "Method and Apparatus for the Performance of Selective Electrodialysis"
- 44) C. Linder, M. Perry, R. Katraró, US 4,753,725 Sept 16, 1980, "Semipermeable Composite Membranes, their Manufacture and Use", Modified Polyvinyl Alcohol Membranes+ world wide patents.
- 45) C. Linder, Is patent 53072 " An Antibiotic formulation containing clindamycin for the treatment of bovine mastitis".