BIOGRAPHICAL SKETCH

Provide the following information for the key personnel in the order listed on Form Page 2.
Photocopy this page or follow this format for each person.

NAME	POSITION TITLE
RAOUL KOPELMAN	Professor of Chemistry, Physics & Applied Physics

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

INSTITUTION AND LOCATION	DEGREE (*if applicable*)	YEAR(s)	FIELD OF STUDY
Chemical Engineering, Israel Institute of Technology	B.S., Dipl Eng	1955, 1956	Chemical Engineering
Israel Institute of Technology	M.S..	1957	Physical Chemistry
Columbia University	Ph.D.	1960	Chemistry
Chemistry, Harvard University	Postdoc.	1960-1962	Chemistry

RESEARCH AND PROFESSIONAL EXPERIENCE: Concluding with present position, list, in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List, in chronological order, the titles, all authors, and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. If the list of publications in the last three years exceeds two pages, select the most pertinent publications. **DO NOT EXCEED TWO PAGES.**

EMPLOYMENT

The University of Michigan, Kasimir Fajans Collegiate Prof. of Chemistry, Physics & Applied Physics, 1994-.
The University of Michigan, Member, Biologic Nanotechnology Center, Medical School, 1998 -.
The University of Michigan, Prof. of Chemistry & Physics; Member, Biophys. Program, 1991-.
The University of Michigan, Prof. of Chemistry, 1971-.
The University of Michigan, Assoc. Prof. of Chemistry, 1968-71.
The University of Michigan, Asst. Prof. of Chemistry, 1966-68.
California Inst. of Technology, Senior Research Fellow, 1964-66
Visiting Prof., Center for Nanoscience and Nanotechnology, Tel-Aviv University, 2001-2002.
Visiting Prof., Tel-Aviv University, Institute of Chemistry, 1994-95.
Visiting Prof., Hebrew Univ. of Jerusalem, Dept. of Applied Physics & Materials Sci., 1989.
Visiting Prof., Swiss Federal Inst. of Technology, Zurich, Dept. of Physical Chemistry, 1988.
Visiting Prof., University of California, San Diego, Institute for Nonlinear Science, 1987-88.
Visiting Prof., University of Stuttgart, Institute of Physics, 1981.

HONORS AND AWARDS

ACS Edward Morley Award and Medal, 1997.
John S. Guggenheim Fellowship, 1995.
Lady Davis Fellowship, 1995.
Fellow of the AAAS, 1994.
Collegiate Professorship (Fajans Chair), 1994.
Festschrift issue of *J. Phys. Chem.* 1994.
Margaret and Herman Sokol Award, 1993.
Faculty Recognition Award, U. of Mich., 1990.
Distinguished Faculty Award, U. of M., 1989.
Fulbright Research Award, 1987-89.
NIH Nat'l. Research Service Award, 1987-88.
NSF Creativity Award, 1986.
Fellow, American Physical Society, 1984-.
NIH Senior Int'l. Fellowship (Fogarty), 1979.
NATO Senior Fellowship, 1976.
NIH Special Research Fellowship, 1972-73.

SELECTED RELEVANT PUBLICATIONS (OUT OF 425 TOTAL)

Clark, H. A., Kopelman, R., Philbert, M. A., et. al. Subcellular Optochemical Nanobiosensors: Probes Encapsulated by Biologically Localized Embedding (PEBBLEs). Sensors and Actuators B 51, 12-16 (1998).

Swallen, S.F., Shi, Z.Y., Tan, W.H., Xu, Z.F., Moore, J.S. and Kopelman, R., Exciton localization hierarchy and directed energy transfer in conjugated linear aromatic chains and dendrimeric supermolecules. Journal of Luminescence, 76-7, 193-196 (1998).

Saxena, I. F., Rao, S. V., Lieberman, R. A., Miller, M. T. and Kopelman, R., Multianalyte Submicron Sensors for Intracellular Sensing, Proceedings SPIE (Int. Soc. Opt. Eng.) 3540, 206-209 (1999).

Kopelman, R., Miller, M. T., Brasuel, M. Clark, H. A., Hoyer, M. and Philbert, M., Optochemical Nanosensors for Intracellular Chemical Measurement, Proceedings SPIE (Int. Soc. Opt. Eng.) 3540, 198-205 (1999).

Dourado, S. and Kopelman, R., Development of Fluorescent Fiber-Optic Single Polymer Membrane Sensors for Simultaneous Ratiometric Detection of Oxygen and Carbon Dioxide in Biological Systems, Proceedings SPIE (Int. Soc. Opt. Eng.) 3540, 224-234 (1999).

Chen-Esterlit, Z., Aylott, J. and Kopelman, R., Development of Oxygen and pH Optical Sensors Using Phase Modulation Technique, Proceedings SPIE (Int. Soc. Opt. Eng.) 3540, 19-26 (1998).

Tan, W. and Kopelman, R., "Nanoscopic Optical Sensors and Probes," Chapter in *Handbook of Nanostructured Materials and Nanotechnology*, edited by H. S. Nalwa, Academic Press, San Diego, Vol. 4, Chapter 10 (1999), pp. 622-667.

Clark, H. A., Hoyer, M., Philbert, M. A. and Kopelman, R., Optical Nanosensors for Chemical Analysis Inside Single Living Cells Part 1: Fabrication, Characterization and Methods for Intracellular Delivery, Anal. Chem. 71, 4831-4836 (1999).

Clark, H. A., Kopelman, R., Tjalkens, R. and Philbert, M. A., Optical Nanosensors for Chemical Analysis Inside Single Living Cells Part 2: Sensors for pH and Calcium and the Intracellular Application of PEBBLE Sensors, Anal. Chem., 71, 4837-4843 (1999).

Clark, H. A., Hoyer, M., Parus, S., Philbert, M. A. and Kopelman, R., Optochemical Nanosensors and Subcellular Applications in Living Cells, Mikrochimica Acta 131, 121-128 (1999).

Tan, W., Kopelman, R., Barker, S. L. R. and Miller, M. T., Ultrasmall Optical Sensors for Cellular Measurements, Analyt. Chem. 71, 606A-612A (1999).

Barker, S. L. R., Zhao, Y., Marletta, M. and Kopelman, R., Cellular Applications of a Sensitive and Selective Fiber-Optic Nitric Oxide Biosensor Based on a Dye-Labeled Heme Domain of Soluble Guanylate Cyclase, Anal. Chem. 71, 2071-2075 (1999).

Swallen, S. F., Kopelman, R., Moore, J. and DeVadoss, C., Dendrimeric Photoantenna Supermolecules: Energetic Funnels, Exciton Hopping, and Unusual Excimer Formation, in L. S. Bartell Special Issue, Molecules and Aggregates: Structure and Dynamics, eds. R. Kuczkowski and L. Laane, J. Mol. Structure 485-486, 585-597 (1999).

Dynamics in Small Confining Systems IV edited by J. M. Drake, G. S. Grest, J. Klafter and R. Kopelman, Materials Research Society Symposium Proceedings 543, 1-372 (1999).

Zhao, X., Yen, A. and Kopelman, R., Monte Carlo Simulation of Surface Adsorption-Diffusion-Reaction Kinetics, J. Phys. Chem. B 103, 1930-1933 (1999).

Monson, E. and Kopelman, R. Experimental Chemical Kinetics of an $A + B \rightarrow 0$ System Showing Non-Classical Effects of Initial Reactant Distribution, in *Dynamics in Small Confining Systems IV*, edited by J. M. Drake, G. S. Grest, J. Klafter and R. Kopelman, Materials Research Society Symposium Proceedings 543, 255-262 (1999).

Tan, W., Lou, J. H. and Kopelman, R., Intracellular Sensing and Optical Imaging Beyond the Diffraction Limit, in *Applications of Optical Engineering to the Study of Pathology*, edited by E. Kohen, Research Signpost, India 3, 47-65 (1999).

Barker, S. L. R., Clark, H. A., Swallen, S. F., Kopelman, R., Tsang, A. W. and Swanson, J. A., Ratiometric and Fluorescence Lifetime Based Biosensors Incorporating Cytochrome c′ and the Detection of Extra- and Intracellular Macrophage Nitric Oxide, Anal. Chem. 71, 1767-1772 (1999).

Swallen, S. F., Kopelman, R. and Moore, J. S., Excited State Dynamics in Organic Dendrimer Supermolecules, chapter in Proceedings of the Third International Conference on Excitonic Processes in Condensed Matter, PV 98-25, edited by R. T. Williams and W. M. Yen, The Electrochemical Society, Pennington, N.J. (1999), pp. 85-.

Kopelman, R., Clark, H., and Barker, S., Optical Sensors for the Detection of Nitric Oxide, Patent #6,002,817; Dec. 14, 1999 – issued.

Argyrakis, P., Ahn, J., Lin, A. and Kopelman, R., Scalings of A + B Reaction Kinetics due to Anisotropic Confinements, in *Dynamics in Small Confining Systems IV*, edited by J. M. Drake, G. S. Grest, J. Klafter and R. Kopelman, Materials Research Society Symposium Proceedings 543, 339-344 (1999).

Swallen, S., Kopelman, R. and Moore, J. S., Energy Transfer in Organic Dendrimer Antenna Funnel and Anti-Funnel Supermolecules, in *Dynamics in Small Confining Systems IV*, edited by J. M. Drake, G. S. Grest, J. Klafter and R. Kopelman, Materials Research Society Symposium Proceedings 543, 311-318 (1999).

Yen, A., Zhao, X. and Kopelman, R., Monte Carlo Study of Etching at Silica-Water Interface, in *Dynamics in Small Confining Systems IV*, edited by J. M. Drake, G. S. Grest, J. Klafter and R. Kopelman, Materials Research Society Symposium Proceedings 543, 263-268 (1999).

Park, S. H., Yen, A., Shi, Z.-Y. and Kopelman, R., Crossover Time Behavior in $A + B \rightarrow C$ and $A + 2B \rightarrow C$ Reaction-Diffusion Front Systems in a Capillary, in *Dynamics in Small Confining Systems IV*, edited by J. M. Drake, G. S. Grest, J. Klafter and R. Kopelman, Materials Research Society Symposium Proceedings 543, 237-242 (1999).

Park, S. H., Taitelbaum, H. and Kopelman, R. Competing Elementary Reactions in a Capillary-Two Reaction Fronts Moving in Oppostite Directions, in *Dynamics in Small Confining Systems IV*, edited by J. M. Drake, G. S. Grest, J. Klafter and R. Kopelman, Materials Research Society Symposium Proceedings 543, 249-254 (1999).

Z. Chen-Esterlit, S. F. Peteu, H. A. Clark, W. McDonald and R. Kopelman, A Comparative Study of Optical Fluorescent Nanosensors ("PEBBLEs") and Fiber Optic Microsensors for Oxygen Sensing, SPIE (Int. Soc. Opt. Eng.) **3602**, 156-163 (1999).

E. Monson and R. Kopelman, Observation of Laser Speckle Effects in an Elementary Chemical Reaction, Phys. Rev. Lett. **85**(**3**), 666-669 (2000).

H. A. Clark, G. Merritt and R. Kopelman, Novel Optical Biosensors using a Gold Colloid Monolayer Substrate, SPIE (Int. Soc. Opt. Eng.) Proc. **3922**, 138-146 (2000).

P. Zhang, R. Kopelman and W. Tan, Subwavelength Optical Microscopy and Spectroscopy Using Near-field Optics, Critical Rev. in Solid State and Mat. Sci. **25(2),** 87-162 (2000).

M. Brasuel, R. Kopelman, T.J. Miller, R. Tjalkens, and M.A. Philbert, Fluorescent Nanosensors for Intracellular Chemical Analysis: Decyl Methacrylate Liquid Polymer Matrix and Ion-Exchange-Based Potassium PEBBLE Sensors with Real-Time Application to Viable Rat C6 Glioma Cells, Anal. Chem. **73(10)**, 2221-2228 (2001).

R.R. Agayan, C.F. Schmidt, F. Gittes, and R. Kopelman, Laser Tweezing Near Resonance Absorption, SPIE (Int. Soc. Opt. Eng.) Proc., **4431**, 341-351 (2001).

S.H. Park, S. Parus, R. Kopelman and H. Taitelbaum, Spectrophotometric Observations of Gel-Free Reaction Front Kinetics in Confined Geometry, in *Dynamics in Small Confining Systems V*, edited by J. M. Drake, J. Klafter, P.E. Levitz and M. Urbach, Materials Research Society Symposium Proceedings, **651**, T7.11.1-T7.11.6 (2001).

Y. Cao, J.S. Moore and R. Kopelman, Studies of Temperature-Dependent Excimer-Monomer Conversion in Dendrimeric Antenna Supermolecules by Fluorescence Spectroscopy, in *Dynamics in Small Confining Systems V*, edited by J. M. Drake, J. Klafter, P.E. Levitz and M. Urbach, Materials Research Society Symposium Proceedings, **651**, T7.27.1-T7.27.6 (2001).

E. Monson and R. Kopelman, Observation of Laser Speckle Effects in an Elementary Chemical Reaction, in *Dynamics in Small Confining Systems IV*, edited by J. M. Drake, J. Klafter, P.E. Levitz and M. Urbach, Materials Research Society Symposium Proceedings, **651**, T6.2.1-T6.2.12 (2001).

S.H. Park, S. Parus, R. Kopelman and H. Taitelbaum, Gel-free Experiments on Convection-less Reaction Front Kinetics, Phy. Rev. E, Rapid Communication **64**, 055102-1/4 (2001).

H. Xu, J.W. Aylott, R. Kopelman, T. Miller and M. Philbert, A Real-Time Ratiometric Method for the Determination of Molecular Oxygen Inside Living Cells Using Sol-Gel Based Spherical Optical Nanosensors with Applications to Rat C6 Glioma, Analyt. Chem. **73(17)**, 4124-4133, 2001.

R.R. Agayan, C.F. Schmidt, F. Gittes, and R. Kopelman, Laser Tweezing Near Resonance Absorption, SPIE (Int. Soc. Opt. Eng.) Proc., **4431**, 341-351 (2001).

S.H. Park, S. Parus, R. Kopelman and H. Taitelbaum. Gel-free Experiments on Convection-less Reaction Front Kinetics, Phy. Rev. E, Rapid Communication **64**, 055102-1/4 (2001).

J. Sumner, J.W. Aylott, E. Monson and R. Kopelman, A Fluorescent PEBBLE Nanosensor for Intracellular Free Zinc, Analyst **127**, 11-16, 2002.

S.L.R. Barker, H.A. Clark and R. Kopelman, Optochemical Nanosensors for Noninvasive Cellular Analysis, in *Biomedical Diagnostic Science and Technology*, Law, Akmall and Usmani, Eds., Chapter 7, 139-164, Marcel Dekker, Inc. (New York), 2002.