

REFERENCES

- Adjemian, K.T., Lee, S.J., Srinivasan, S., Benziger, J., and Bocarsly, A.B. (2002) Silicon oxide nafion composite membranes for proton-exchange membrane fuel cell operation at 80-140 degrees C. *Journal of the Electrochemical Society*, 149(3), A256–A261.
- Agbor, N.E., Petty, M.C., and Monkman, A.P. (1995) Polyaniline thin films for gas sensing. *Sensors and Actuators B: Chemical*, 28(3), 173-179.
- Albert, K.J., Lewis, N.S., Schauer, C.L., Sotzing, G.A., Stitzel, S.E., Vaid, T.P., and Walt, D.R. (2000) Cross-reactive chemical sensor arrays. *Chemical Reviews*, 100(7), 2595–2626.
- Angelopoulos, M., Manor, C., Liao, Y.H., and Saraf, R.F. (2003) U.S. Patent 6,616,863 B1.
- Anilkumar, P. and Jayakannan, M. (2007) Single-molecular-system-based selective micellar templates for polyaniline nanomaterials: control of shape, size, solid state ordering, and expanded chain to coil-like conformation. *Macromolecules*, 40(20), 7311–7319.
- Anitha, G. and Subramanian, E. (2003) Dopant induced specificity in sensor behaviour of conducting polyaniline materials with organic solvents. *Sensors and Actuators B: Chemical*, 92(1–2), 49–59.
- Antonucci, P.L., Aricò, A.S., Cretì, P., Ramunni, E., and Antonucci, V. (1999) Investigation of a direct methanol fuel cell based on a composite Nafion®-silica electrolyte for high temperature operation. *Solid State Ionics*, 125(1–4), 431–437.
- Archer, M., Christoffersen, M., and Fauchet, P.M. (2005) Electrical porous silicon chemical sensor for detection of organic solvents. *Sensors and Actuators B: Chemical*, 106(1), 347–357.
- Arici, E., Meissner, D., Schaffler, F., and Saricifci, N.S. (2003) Core/shell nanomaterials in photovoltaics. *International Journal of Photoenergy*, 5(4), 199–208.

- Askim, J.R., Mahmoudi, M., and Suslick, K.S. (2013) Optical sensor arrays for chemical sensing: the optoelectronic nose. *Chemical Society Reviews*, 42(22), 8649–8682.
- Athawale, A.A., Deore, B.A., and Chabukswar, V.V. (1999) Studies on poly(diphenylamine) synthesized electrochemically in nonaqueous media. *Materials Chemistry and Physics*, 58(1), 94–100.
- Athawale, A.A. and Kulkarni, M.V. (2000) Polyaniline and its substituted derivatives as sensor for aliphatic alcohols. *Sensors and Actuators B: Chemical*, 67(1–2), 173–177.
- Auerbach, S.M., Carrado, K.A., and Dutta, P.K. (Eds.). (2003) *Handbook of Zeolite: Science and Technology*. New York: Marcel Dekker.
- Ayad, M.M., El-Hefnawy, G., and Torad, N.L. (2008) Quartz crystal microbalance sensor coated with polyaniline emeraldine base for determination of chlorinated aliphatic hydrocarbons. *Sensors and Actuators B: Chemical*, 134(2), 887–894.
- Bai, H. and Shi, G. (2007) Gas sensors based on conducting polymers. *Sensors*, 7(3), 267–307.
- Bailey, A.I.P.S., Pisanelli, A.M., and Persaud, K.C. (2008) Development of conducting polymer sensor arrays for wound monitoring. *Sensors and Actuators B: Chemical*, 131(1), 5–9.
- Baquerizo, I., Ruiz, H.J.A., and XCabrerizo, G.V. (2000) Measurement of dynamic surface tension to determine critical micellar concentration in lipophilic silicone surfactants. *IL Farmaco*, 55(9-10), 583–589.
- Barisci, J.N., Stella, R., Spinks, G.M., and Wallace, G.G. (2000) Characterisation of the topography and surface potential of electrodeposited conducting polymer films using atomic force and electric force microscopies. *Electrochimica Acta*, 46(4), 519–531.
- Bennur, T.H., Srinivas, D., and Sivasanker, S. (2004) Oxidation of ethylbenzene over “neat” and zeolite-Y-encapsulated copper tri- and tetraaza macrocyclic complexes. *Journal of Molecular Catalysis A: Chemical*, 207(2), 163–171.

- Beyer, H.K. (2002) Dealumination techniques for zeolites. *Molecular Sieves*, 3, 204–255.
- Boubel, R.W., Fox, D.L., Turner, B.R., and Stern, A.C. (Eds.). (1994) *Fundamentals of Air Pollution*. San Diego: Academic Press.
- Butt, H.J., Graf, K., and Kappl, M. (2004) Surfactants, micelles, emulsions, and foams. *Physics and Chemistry of Interfaces* (pp. 246–279). Weinheim: Wiley-VCH.
- Cangelosi, F. and Shaw, M.T. (1983) A review of hydrogen bonding in solid polymers: structural relationships, analysis, and importance. *Polymer-Plastics Technology and Engineering*, 21(1), 13–98.
- Chabukswar, V. and Athawale, A. (2008) Synthesis and characterization studies of organically soluble acrylic acid doped polydiphenylamine. *Chemistry & Chemical Technology*, 2(4), 257–262.
- Chanthanont, P. and Sirivat, A. (2012) Interaction of carbon monoxide with PEDOT-PSS/zeolite composite: effect of Si/Al ratio of ZSM-5 zeolite. *e-Polymer*, 12(1), 106–116.
- Chanthanont, P. and Sirivat, A. (2013) Effect of transition metal ion-exchanged into the zeolite Y on electrical conductivity and response of PEDOT-PSS/MY composites toward SO₂. *Advances in Polymer Technology*, 32(4), 1–6.
- Choi, S.Y., Park, Y.S., Hong, S.B., and Yoon, K.B. (1996) Iodine as a visible probe for the evaluation of zeolite donor strength. *Journal of the American Chemical Society*, 118(39), 9377–9386.
- Chuapradit, C., Wannatong, L.R., Chotpattananont, D., Hiamtup, P., Sirivat, A., and Schwank, J. (2005) Polyaniline/zeolite LTA composites and electrical conductivity response towards CO. *Polymer*, 46(3), 947–953.
- Chung, C.Y., Wen, T.C., and Gopalan, A. (2001) Identification of electrochromic sites in poly(diphenylamine) using a novel absorbance-potential-wavelength profile. *Electrochimica Acta*, 47(3), 423–431.
- Clingerman, M.L., King, J.A., Schulz, K.H., and Meyers, J.D. (2002) Evaluation of electrical conductivity models for conductive polymer composites. *Journal of Applied Polymer Science*, 83(6), 1341–1356.

- Cooper, J.S., Raguse, B., Chow, E., Hubble, L., Müller, K.H., and Wieczorek, L. (2010) Gold nanoparticle chemiresistor sensor array that differentiates between hydrocarbon fuels dissolved in artificial seawater. *Analvtical Chemistry*, 82(9), 3788–3795.
- Contributors. W. "Anesthesia" Wikipedia. 28 Sep 2012. 9 Oct 2012 <<http://en.wikipedia.org/w/index.php?title=Anesthesia&oldid=515002047>>
- Corma, A. (1995) Inorganic solid acids and their use in acid-catalyzed hydrocarbon reactions. *Chemical Reviews*, 95, 559–614.
- Cullis, P.R., Hope, M.J., and Tilcock, C.P.S. (1986) Lipid polymorphism and the roles of lipids in membranes. *Chemistry and Physics of Lipids*, 40(2–4), 127–144.
- Das, T.K. and Prusty, S. (2012) Review on conducting polymers and their applications. *Polymer-Plastics Technology and Engineering*, 51(14), 1487–1500.
- Densakulprasert, N., Wannatong, L., Chotpattananont, D., Hiamtup, P., Sirivat, A., and Schwank, J. (2005) Electrical conductivity of polyaniline/zeolite composites and synergistic interaction with CO. *Materials Science and Engineering: B*, 117(3), 276–282.
- De Santana, H. and Dias, F.C. (2003) Characterization and properties of polydiphenylamine electrochemically modified by iodide species. *Materials Chemistry and Physics*, 82(3), 882–886.
- Dong, A., Wang, Y., Tang, Y., Ren, N., Zhang, Y., Yue, Y., and Gao, Z. (2002) Zeolitic tissue through wood cell templating. *Advanced Materials*, 14(12), 926–929.
- Eftekhari, A. (2010) *Nanostructured Conductive Polymers*. Weinheim: John Wiley.
- El-Shobaky, G.A., Selim, M.M., and Ezzo, E.M. (1979) Effect of water treatment on the catalytic properties of decationated zeolite. *Journal of the Research Institute for Catalysis Hokkaido University*.

- EPA. U. (1991) Needs for eleven TRI organic chemical groups. environmental protection agency. Paper presented at Pollution Prevention Research, Washington. DC, USA.
- EPA. U. (2012) What you should know about the problem of vapor intrusion. Paper presented at Pollution Prevention Research. Washington. DC. USA.
- Esumi. K. and Ueno, M. (2003) Structure-Performance Relationships in Surfactants. New York: Marcel Dekker.
- Featherstone. H.W. (1947) Chloroform. Anesthesiology, 8(4). 362–371.
- Feng. J. and MacDiarmid. A.G. (1999) Sensors using octaaniline for volatile organic compounds. Synthetic Metals, 102(1–3). 1304–1305.
- Freund, M.S. and Deore. B. (2007) Self-Doped Conducting Polymers. New York: John Wiley.
- George E. and Christidis. H.P. (2008) Synthesis of FAU type zeolite Y from natural raw materials: hydrothermal SiO₂ sinter and perlite glass. The Open Mineralogy Journal, 2(1). 1–5.
- Gök. A., Omastová, M., and Yavuz, A.G. (2007) Synthesis and characterization of polythiophenes prepared in the presence of surfactants. Svnthetic Metals, 157(1). 23–29.
- González. M.D., Cestros. Y., and Salagre. P. (2011) Comparison of dealumination of zeolites beta, mordenite and ZSM-5 by treatment with acid under microwave irradiation. Microporous and Mesoporous Materials, 144(1–3). 162–170.
- Gopalakrishnan. K., Elango. M., and Thamilselvan. M. (2012) Optical studies on nano-structured conducting polyaniline prepared by chemical oxidation method. Archives of Physics Research, 2(4). 315–319.
- Gopalan, A.I., Kwang, P.I., Manian, K.M.P., Santhosh, P., Kap, D.S., and Duk, D.I.. (2006) Fabrication of functional nanofibrous ammonia sensor. in Nanotechnology. Paper presented at IEEE-NANO 2006. Sixth IEEE Conference. Cincinnati. Ohio.
- Gopel, W. (1995) Nanostructured sensors for molecular recognition. Philosophical Transactions: Physical Sciences and Engineering, 353(1703). 333–354.

- Grate, J.W., Kaganove, S.N., and Nelson, D.A. (2001) Polymers for chemical sensors using hydrosilylation chemistry. Report, Pacific Northwest National Laboratory, The U.S. Department of Energy, Washington, USA.
- Guan, G., Liu, B., Wang, Z., and Zhang, Z. (2008) Imprinting of molecular recognition sites on nanostructures and its applications in chemosensors. *Sensors*, 8(12), 8291–8320.
- Hangarter, C.M., Bangar, M., Mulchandani, A., and Myung, N.V. (2010) Conducting polymer nanowires for chemiresistive and FET-based bio/chemical sensors. *Journal of Materials Chemistry*, 20(16), 3131–3140.
- Hansen, C.M. (1967) *The Three Dimensional Solubility Parameter and Solvent Diffusion Coefficient: their Importance in Surface Coating Formation*. Copenhagen: Danish Technical Press.
- Hansen, C.M. (2012) *Hansen Solubility Parameters: A User's Handbook*. Second Edition. New York: Taylor & Francis.
- Harada, A., Kobayashi, R., Takashima, Y., Hashidzume, A., and Yamaguchi, H. (2011) Macroscopic self-assembly through molecular recognition. *Nature Chemistry*, 3(1), 34–37.
- Ho, G.W. (2011) Gas sensor with nanostructured oxide semiconductor materials. *Science of Advanced Materials*, 3(2), 150–168.
- Holmberg, B.A., Wang, H., and Yan, Y. (2004) High silica zeolite Y nanocrystals by dealumination and direct synthesis. *Microporous and Mesoporous Materials*, 74(1–3), 189–198.
- Hua, F. and Ruckenstein, E. (2003) Water-soluble conducting poly(ethylene oxide)-grafted polydiphenylamine synthesis through a “Graft Onto” process. *Macromolecules*, 36(26), 9971–9978.
- Hua, F. and Ruckenstein, E. (2005) Hyperbranched sulfonated polydiphenylamine as a novel self-doped conducting polymer and its pH response. *Macromolecules*, 38(3), 888–898.
- Huang, J. and Kaner, R.B. (2003) A general chemical route to polyaniline nanofibers. *Journal of the American Chemical Society*, 126(3), 851–855.

- Huang, J. and Kaner, R.B. (2006) The intrinsic nanofibrillar morphology of polyaniline. *Chemical Communications*, 0(4), 367–376.
- Huang, J., Virji, S., Weiller, B.H., and Kaner, R.B. (2002) Polyaniline nanofibers: facile synthesis and chemical sensors. *Journal of the American Chemical Society*, 125(2), 314–315.
- Huang, J., Wang, K., and Wei, Z. (2010) Conducting polymer nanowire arrays with enhanced electrochemical performance. *Journal of Materials Chemistry*, 20(6), 1117–1121.
- Hugon, O., Sauvan, M., Benech, P., Pijolat, C., and Lefebvre, F. (2000) Gas separation with a zeolite filter, application to the selectivity enhancement of chemical sensors. *Sensors and Actuators B: Chemical*, 67(3), 235–243.
- Hunter, C.A. (2004) Quantifying intermolecular interactions: guidelines for the molecular recognition toolbox. *Angewandte Chemie International Edition*, 43(40), 5310–5324.
- Israelachvili, J.N., Marčelja, S., and Horn, R.G. (1980) Physical principles of membrane organization. *Quarterly Reviews of Biophysics*, 13(02), 121–200.
- James, D., Scott, S.M., Ali, Z., and O'Hare, W.T. (2005) Chemical sensors for electronic nose systems. *Microchimica Acta*, 149(1), 1–17.
- Janata, J. (2001) Centennial retrospective on chemical sensors. *Analytical Chemistry*, 73(5), 150 A–153 A.
- Janata, J. and Josowicz, M. (2003) Conducting polymers in electronic chemical sensors. *National Materials*, 2, 19–24.
- Janata, J. and Josowicz, M. (2009) Organic semiconductors in potentiometric gas sensors. *Journal of Solid State Electrochemistry*, 13(1), 41–49.
- Jang, J. (2006) *Conducting Polymer Nanomaterials and their Applications*, in *Emissive Materials Nanomaterials*. (pp. 189–260). Berlin: Springer.
- Jiang, L., Jun, H.K., Hoh, Y.S., Lim, J.O., Lee, D.D., and Huh, J.S. (2005) Sensing characteristics of polypyrrole–poly(vinyl alcohol) methanol sensors prepared by in situ vapor state polymerization. *Sensors and Actuators B: Chemical*, 105(2), 132–137.

- Jing, S. (2010) Synthesis, characterization and application of micro/nano structure conducting polymers. Ph.D. Dissertation, School of Chemical Sciences, University of Auckland, Auckland, Newzealand.
- Jose, K.A., Biju, P., Ashwin, W., Vijay, K.V., and Reddy, C.C. (2004) A compact wireless gas sensor using a carbon nanotube/PMMA thin film chemiresistor. *Smart Materials and Structures*, 13(5), 1045.
- Kamonsawas, J., Sirivat, A., Niamlang, S., Hormnirun, P., and Prissanaroon-Ouajai, W. (2010) Electrical conductivity response of poly(phenylene-vinylene)/zeolite composites exposed to ammonium nitrate. *Sensors*, 10(6), 5590–5603.
- Kaneyasu, K., Otsuka, K., Setoguchi, Y., Sonoda, S., Nakahara, T., Aso, I., and Nakagaichi, N. (2000) A carbon dioxide gas sensor based on solid electrolyte for air quality control. *Sensors and Actuators B: Chemical*, 66(1–3), 56–58.
- King, R.C.Y. and Roussel, F. (2009) Toward a simple method for the fabrication of 1D or 3D nanostructures of polyaniline. *Synthetic Metals*, 159(23–24), 2512–2518.
- Kondru, A.K., Pradeep, K., and Shri, C. (2009) Catalytic wet peroxide oxidation of azo dye (Congo red) using modified Y zeolite as catalyst. *Journal of Hazardous Materials*, 166(1), 342–347.
- Konkayan, S., Chanthaanont, P., Prissanaroon, W., Hormnirun, P., and Sirivat, A. (2013) Ammonia sensing and electrical properties based on composite of poly(3-thiopheneacetic acid) and zeolite Y. *Materials Technology: Advanced Performance Materials*, 28(6), 332–338.
- Kukla, A.L., Pavluchenko, A.S., Shirshov, Y.M., Konoshchuk, N.V., and Posudievsky, O.Y. (2009) Application of sensor arrays based on thin films of conducting polymers for chemical recognition of volatile organic solvents. *Sensors and Actuators B: Chemical*, 135(2), 541–551.
- Kumar, S., Sinha, A.K., Hegde, S.G., and Sivasanker, S. (2000) Influence of mild dealumination on physicochemical, acidic and catalytic properties of H-ZSM-5. *Journal of Molecular Catalysis A: Chemical*, 154(1–2), 115–120.

- Kumar, S. (2006, October) Organic Chemistry: Spectroscopy of organic compounds. Report, Department of Chemistry, Guru Nanak Dev University, Amritsar, India.
- Kwon, O.S., Park, S.J., Lee, J.S., Park, E., Kim, T., Park, H.W., You, S.A., Yoon, H., and Jang, J. (2012) Multidimensional conducting polymer nanotubes for ultrasensitive chemical nerve agent sensing. *Nano Letters*, 12(6), 2797–2802.
- Lambert, J.B., Gronert, S., Shurvell, H.F., and Lightner, D. (2010) *Organic Structural Spectroscopy*. New Jersey: Prentice Hall PTR.
- Lee, D.U., Jang, S.R., Vittal, R., Lee, J., and Kim, K.J. (2008) CTAB facilitated spherical rutile TiO₂ particles and their advantage in a dye-sensitized solar cell. *Solar Energy*, 82(11), 1042–1048.
- Li, C.Y., Wen, T.C., Guo, T.F., and Hou, S.S. (2008) A facile synthesis of sulfonated poly(diphenylamine) and the application as a novel hole injection layer in polymer light emitting diodes. *Polymer*, 49(4), 957–964.
- Liang, L., Guangzhong, X., Yadong, J., Xiaosong, D., and Ping, S. (2009, October) Organic vapor adsorption behavior of poly (3-henxylthiophene) films on quartz crystal microbalance. Paper presented at 2009 International Conference on Optical Instruments and Technology: Advanced Sensor Technologies and Applications, Shanghai, China.
- Liu, X., Cheng, S., Liu, H., Hu, S., Zhang, D., and Ning, H. (2012) A survey on gas sensing technology. *Sensors*, 12, 9635–9665.
- Looek, H.P. and Wentzell, P.D. (2012) Detection limits of chemical sensors: Applications and misapplications. *Sensors and Actuators B: Chemical*, 173(0), 157–163.
- Lu, L., Xie, G., Jiang, Y., Du, X., and Sun, P. (2009, October) Organic vapor adsorption behavior of poly(3-henxylthiphene) films on quartz crystal microbalance. Paper presented at 2009 International Conference on Optical Instruments and Technology:Advanced Sensor Technologies and Applications, Shanghai, China.

- Luo, Y.L., Miao, Y., Xu, F., and Yao, Y. (2012) Novel HTPB/MWNTs-COOH PU conductive polymer composite films for detection of hazardous organic solvent vapors. *Polymer-Plastics Technology and Engineering*. 51(3), 290–297.
- Lyon, R.E. (1998) Pyrolysis kinetics of char forming polymers. *Polymer Degradation and Stability*. 61(2), 201–210.
- Ma, W., Yang, H., Wang, W., Gao, P., and Yao, J. (2011) Ethanol vapor sensing properties of triangular silver nanostructures based on localized surface plasmon resonance. *Sensors*. 11(9), 8643–8653.
- Martin, H.P., Muller, E., Richter, R., Roewer, G., and Brendler, E. (1997) Conversion process of chlorine containing polysilanes into silicon carbide: Part I Synthesis and crosslinking of poly(chloromethyl)silanes–carbosilanes and their transformation into inorganic amorphous silicon carbide. *Journal of Materials Science*. 32(5), 1381–1387.
- Massoumi, B., Najafian, S., and Entezami, A.A. (2010) Investigation of conductivity and morphology of poly(diphenylamine-co-aniline) prepared via chemical and electrochemical copolymerization. *Polymer Science Series B*. 52, 270–276.
- Maxwell, I.E. and Stork, W.H.J. (2001) Hydrocarbon processing with zeolites. in Studies in Surface Science and Catalysis. In H.V. Bekkum, E.M. Flanigen, and P.A. Jacobs (Eds). *Studies in Surface Science and Catalysis* (pp. 747–8190). Rio de Janeiro: Elsevier.
- Meier, B., Werner, T., Klimant, I., and Wolfbeis, O.S. (1995) Novel oxygen sensor material based on a ruthenium bipyridyl complex encapsulated in zeolite Y: dramatic differences in the efficiency of luminescence quenching by oxygen on going from surface-adsorbed to zeolite-encapsulated fluorophores. *Sensors and Actuators B: Chemical*. 29(1–3), 240–245.
- Mehta, S.K., Kumar, S., Chaudhary, S., and Bhasin, K.K. (2010) Nucleation and growth of surfactant-passivated CdS and HgS nanoparticles: Time-dependent absorption and luminescence profiles. *Nanoscale*. 2(1), 145–152.

- Miguel. R., Rafael. L.E., and Manfred. J.H. (2003) Evaluation of zeolite-water solar adsorption refrigerator. Paper presented at ISES Solar World Congress, Sweden.
- Müller-Dethlefs, K. and Hobza, P. (1999) Noncovalent interactions: A challenge for experiment and theory. Chemical Reviews. 100(1), 143–168.
- Nambiar, S. and Yeow, J.T.W. (2011) Conductive polymer-based sensors for biomedical applications. Biosensors and Bioelectronics. 26(5), 1825–1832.
- National Oceanic and Atmospheric Administration, U.D.o.C., US Goverment. “Immediately Dangerous to Life and Health Limits (IDLHs).” 6 Nov 2012. 7 Nov 2012<<http://response.restoration.noaa.gov/idlhs>>
- Nicholas, J.P. (2013) Electrospun conducting polymer nanofibers as the active material in sensors and diodes. Journal of Physics: Conference Series. 421(1), 012004.
- Orlov, A., Ozkan, S., and Karpacheva, G. (2006) Oxidative polymerization of diphenylamine: A mechanistic study. Polymer Science Series B. 48(1), 11–17.
- Palaniappan, S.P. and Manisankar, P. (2011) Mechanochemical preparation of polydiphenylamine and its electrochemical performance in hybrid supercapacitors. Electrochimica Acta. 56(17), 6123–6130.
- Pang, S., Li, G., and Zhang, Z. (2005) Synthesis of polyaniline-vanadium oxide nanocomposite nanosheets. Macromolecular Rapid Communications. 26(15), 1262–1265.
- Paradee, N. and Sirivat, A. (2013) Synthesis of poly(3,4-ethylenedioxothiophene) nanoparticles via chemical oxidation polymerization. Polymer International. 63(1), 106–113.
- Partridge, A.C., Jansen, M.L., and Arnold, W.M. (2000) Conducting polymer-based sensors. Materials Science and Engineering: C. 12(1–2), 37–42.
- Payra, P. and Dutta, P.K. (2003) Development of a dissolved oxygen sensor using tris(bipyridyl) ruthenium (II) complexes entrapped in highly siliceous zeolites. Microporous and Mesoporous Materials. 64(1–3), 109–118.

- Penza, M. and Cassano, G. (2003) Application of principal component analysis and artificial neural networks to recognize the individual VOCs of methanol/2-propanol in a binary mixture by SAW multi-sensor array. *Sensors and Actuators B: Chemical*, 89(3), 269–284.
- Permpool, T., Sirivat, A., and Aussawasathien, D. (2014) Synthesis of polydiphenylamine with tunable size and shape via emulsion polymerization. *Polymer International*. (in press).
- Permpool, T., Supaphol, P., Sirivat, A., and Wannatong, L. (2012) Polydiphenylamine–polyethylene oxide blends as methanol sensing materials. *Advances in Polymer Technology*, 31(4), 401–413.
- Permpool, T., Sirivat, A., Aussawasathien, D., and Wannatong, L. (2013) Development of polydiphenylamine/zeolite Y composite by dealumination process as a sensing material for halogenated solvents. *Polymer-Plastics Technology and Engineering*, 52, 907–920.
- Petrenko, V.I., Avdeev, M.V., Garamus, V.M., Bulavin, L.A., Aksenov, V.L., and Rosta, L. (2010) Micelle formation in aqueous solutions of dodecylbenzene sulfonic acid studied by small-angle neutron scattering. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 369(1–3), 160–164.
- Phumman, P., Niamlang, S., and Sirivat, A. (2009) Fabrication of poly(p-Phenylene)/zeolite composites and their responses towards ammonia. *Sensors*, 9(10), 8031–8046.
- Potyrailo, R.A., Surman, C., Nagraj, N., and Burns, A. (2011) Materials and transducers toward selective wireless gas sensing. *Chemical Reviews*, 111(11), 7315–7354.
- Ragupathy, D., Gopalan, A., and Lee, K.P. (2009) Layer-by-layer electrochemical assembly of poly(diphenylamine)/phosphotungstic acid as ascorbic acid sensor. *Microchimica Acta*, 166(3), 303–310.
- Rigby, M. (1986) *The Forces between Molecules*. Oxford: Clarendon Press.
- Rodríguez Presa, M.J., Posadas, D., and Florit, M.I. (2007) Conditioning treatment to improve the potentiometric pH response of polydiphenylamine modified electrodes. *Sensors and Actuators B: Chemical*, 123(1), 142–147.

- Ronkainen, N.J., Halsall, H.B.. and Heineman, W.R. (2010) Electrochemical biosensors. *Chemical Society Reviews*, 39(5), 1747–1763.
- Sahner, K., Hagen, G., Schönauer, D., Reiß, S., and Moos, R. (2008) Zeolites — versatile materials for gas sensors. *Solid State Ionics*, 179(40), 2416-2423.
- Saidina, A.N.A. and Anggoro, D.D. (2002) Dealuminated ZSM-5 zeolite catalyst for ethylene oligomerization to liquid fuels. *Journal of Natural Gas Chemistry*, 11(1), 79–86.
- Saini, D. and Basu, T. (2012) Synthesis and characterization of nanocomposites based on polyaniline-gold/graphene nanosheets. *Applied Nanoscience*, 2(4), 467–479.
- Santana, H. and Temperini, M. (1996) The spectroscopic characterization of polydiphenylamine and one of its oligomeric fractions. *Journal of the Brazilian Chemical Societies* 7(6), 485–490.
- Santhosh, P., Manesh, K.M., Gopalan, A., and Lee, K.P. (2007) Novel amperometric carbon monoxide sensor based on multi-wall carbon nanotubes grafted with polydiphenylamine—fabrication and performance. *Sensors and Actuators B: Chemical*, 125(1), 92–99.
- Santhosh, P., Manesh, K.M., Uthayakumar, S., Gopalan, A.I., and Lee, K.P. (2009) Hollow spherical nanostructured polydiphenylamine for direct electrochemistry and glucose biosensor. *Biosensors and Bioelectronics*, 24(7), 2008–2014.
- Satcher, D. "Immediately Dangerous To Life or Health (IDLH)." May 1994, 31 March 2013 <<http://www.cdc.gov/niosh/idlh/intridl4.html>>
- Sathiyanarayanan, S., Muthukrishnan, S., and Venkatachari, G. (2006) Synthesis and anticorrosion properties of polydiphenylamine blended vinyl coatings. *Synthetic Metals*, 156(18–20), 1208–1212.
- Sawall, D.D., Villahermosa, R.M., Lipeles, R.A., and Hopkins, A.R. (2004) Interfacial polymerization of polyaniline nanofibers grafted to Au surfaces. *Chemistry of Materials*, 16(9), 1606–1608.
- Shamloo, A., Vosoughi, M., Alemzadeh, I., Naeini, A.T., and Darvish, M. (2012) Two nano structured polymers: polyaniline nanofibers and new linear-

- dendritic matrix of poly(Citric Acid)-block-poly(ethylene glycol) copolymers for environmental monitoring in novel biosensors. *International Journal of Polymeric Materials*. 62(7). 377–383.
- Sharma, S. and Kumar, D. (2010) Study on solvatochromic behavior of polyaniline and alky substituted polyanilines. *Indian Journal of Engineering and Sciences*. 17, 231–237.
- Shirazi, L., Jamshidi, E., and Ghasemi, M.R. (2008) The effect of Si/Al ratio of ZSM-5 zeolite on its morphology, acidity and crystal size. *Crystal Research and Technology*. 43(12), 1300–1306.
- Shough, A.M. (2008) Quantum chemistry studies of catalytic and photocatalytic materials: transition metal substitution, active sites, thermodynamics and reaction mechanisms. Ph.D. Dissertation, University of Delaware, Newark, DE, USA.
- Shukla, P., Bhatia, V., Gaur, V., and Jain, V.K. (2011) Electrostatically functionalized multiwalled carbon nanotube/PMMA composite thin films for organic vapor detection. *Polymer-Plastics Technology and Engineering*. 50(11), 1179–1184.
- Sidebottom, H. and Franklin, J. (1996) The atmospheric fate and impact of hydrochlorofluorocarbons and chlorinated solvents. *Pure and Applied Chemistry*. 68(9), 1757–1769.
- Silberberg, M.S. (2006) *Principles of General Chemistry*. Ohio: McGraw-Hill Higher Education.
- Silverstein, R.M., Webster, F.X., and Kiemle, D. (2005) *Spectrometric Identification of Organic Compounds*. New York: John Wiley.
- Smallwood, I.M. (1996) *Handbook of Organic Solvent Properties*. New York: John Wiley.
- Srinivas, C.H., Srinivasu, D., Kavitha, B., Narsimlu, N., and Kumer, K.S. (2012) Synthesis and characterization of nano size conducting polyaniline. *IOSR Journal of Applied Physics*. 1(5), 12–15.

- Stejskal, J., Omastová, M., Fedorova, S., Prokeš, J., and Trchová, M. (2003) Polyaniline and polypyrrole prepared in the presence of surfactants: A comparative conductivity study. *Polymer*, 44(5), 1353–1358.
- Suganandam, K., Santhosh, P., Sankarasubramanian, M., Gopalan, A., Vasudevan, T., and Lee, K.P. (2005) Fe^{3+} ion sensing characteristics of polydiphenylamine—electrochemical and spectroelectrochemical analysis. *Sensors and Actuators B: Chemical*, 105(2), 223–231.
- Tauc, J., Grigorovici, R., and Vancu, A. (1966) Optical properties and electronic structure of amorphous germanium. *Physica Status Solidi B*, 15(2), 627–637.
- Thuwachaowsoan, K., Chotpattananont, D., Sirivat, A., Rujiravanit, R., and Schwank, J.W. (2007) Electrical conductivity responses and interactions of poly(3-thiopheneacetic acid)/zeolites L, mordenite, beta and H_2 . *Materials Science and Engineering: B*, 140(1–2), 23–30.
- Titova, T.I., Kosheleva, L.S., Zhdanov, S.P., and Shubaeva, M.A. (1993) IR spectroscopic study of structure-chemical aspects of the Na-Y zeolite dealumination with ethylene diamine tetraacetic acid. *Pure and Applied Chemistry*, 65(10), 2231–2236.
- Tomchenko, A.A., Harmer, G.P., Marquis, B.T., and Allen, J.W. (2003) Semiconducting metal oxide sensor array for the selective detection of combustion gases. *Sensors and Actuators B: Chemical*, 93(1–3), 126–134.
- Triantafyllidis C.S., Vlessidis A.G., and Evmiridis, N.P. (2000) Dealuminated H-Y zeolites : Influence of the degree and the type of dealumination method on the structural and acidic characteristics of H-Y zeolites. *Industrial & Engineering Chemistry Research*, 39(2), 307–319.
- Tsai, Y.T., Wen, T.C., and Gopalan, A. (2003) Tuning the optical sensing of pH by poly(diphenylamine). *Sensors and Actuators B: Chemical*, 96(3), 646–657.
- Tungkavet, T., Pattavarakorn, D., and Sirivat, A. (2012) Bio-compatible gelatins (Ala-Gly-Pro-Arg-Gly-Glu-4Hyp-Gly-Pro-) and electromechanical properties: effects of temperature and electric field. *Polymer Research*, 19, 9759–9763.

- Tukker, A. and Simons, Ir.L.Ph. (1999) Methylene chloride: advantages and drawbacks of possible market restrictions in the EU. Report, DG III of the European Commission, Brussels, Belgium.
- Udum, Y.A., Pekmez, K., and Yıldız, A. (2004) Electropolymerization of self-doped polythiophene in acetonitrile containing FSO_3H . *Synthetic Metals*, 142(1–3), 7–12.
- Valkenberg, M.H. and Holderich, W.F. (2002) Preparation and use of hybrid organic-inorganic catalysts. *Catalysis Reviews-Science and Engineering*, 44(2), 321–374.
- Vito, S.D. and Martin, C.R. (1998) Toward colloidal dispersions of template-synthesized polypyrrole nanotubules. *Chemistry of Materials*, 10(7), 1738–1741.
- Vivekanandan, J., Ponnusamy, V., Mahudeswaran, A., and Vijayanand, P.S. (2011) Synthesis, characterization and conductivity study of polyaniline prepared by chemical oxidative and electrochemical methods. *Archives of Applied Science Research*, 3(6), 147–153.
- Wang, K., Wu, H., Meng, Y., and Wei, Z. (2014) Conducting polymer nanowire arrays for high performance supercapacitors. *Small*, 10(1), 14–31.
- Wan, M. (2008) A template-free method towards conducting polymer nanostructures. *Advanced Materials*, 20(15), 2926–2932.
- Wan, M., Huang, J., and Shen, Y. (1999) Microtubes of conducting polymers. *Synthetic Metals*, 101(1–3), 708–711.
- Wang, J., Bunimovich, Y.L., Sui, G., Savvas, S., Wang, J., Guo, Y., Heath, J.R., and Tseng, H.R. (2006) Electrochemical fabrication of conducting polymer nanowires in an integrated microfluidic system. *Chemical Communications*, 0(29), 3075–3077.
- Wang, J., Wang, J., Yang, Z., Wang, Z., Zhang, F., and Wang, S. (2008) A novel strategy for the synthesis of polyaniline nanostructures with controlled morphology. *Reactive and Functional Polymers*, 68(10), 1435–1440.

- Whitaker, A.M. and Jones, C.S. (1965) Report of 1500 chloroform anesthetics administered with a precision vaporizer. *Anesthesia & Analgesia*, 44(1), 60–65.
- Williams, P.L., James, R.C., and Roberts, S.M. (2000) *Principles of Toxicology: Environmental and Industrial Applications*. New York: John Wiley.
- Wu, J.Y., Liu, Q.L., Xiong, Y., Zhu, A.M., and Chen, Y. (2009) Molecular simulation of water/alcohol mixtures' adsorption and diffusion in zeolite 4A membranes. *The Journal of Physical Chemistry B*, 113(13), 4267–4274.
- Xia, Y., Liu, S., Wang, X., Han, Y., Li, J., and Jian, X. (2008) The analysis of synergistic effects of zeolites applied in intumescent halogen-free flame-retardant ABS composites. *Polymer-Plastics Technology and Engineering*, 47(6), 613–618.
- Xie, H., Yang, Q.D., Sun, X., Yu, T., Huang, J.Z., and Huang, Y. (2005) Gas sensors based on nanosized-zeolite films to identify dimethylmethylphosphonate. *Sensors and Materials*, 17(1), 21–28.
- Xu, J.C., Liu, W.M., and Li, H.L. (2005) Titanium dioxide doped polyaniline. *Materials Science and Engineering: C*, 25(4), 444–447.
- Xu, L., Hu, X., Tze Lim, Y., and Subramanian, V.S. (2002) Organic vapor adsorption behavior of poly(3-butoxythiophene) LB films on quartz crystal microbalance. *Thin Solid Films*, 417(1–2), 90–94.
- Xu, X., Wang, J., and Long, Y. (2006) Zeolite-based materials for gas sensors. *Sensors*, 6(12), 1751–1764.
- Yoon, H. and Jang, J. (2009) Conducting-polymer nanomaterials for high-performance sensor applications: Issues and challenges. *Advanced Functional Materials*, 19(10), 1567–1576.
- Zhao, Y., Chen, M., Liu, X., Xu, T., and Liu, W. (2005) Electrochemical synthesis of polydiphenylamine nanofibrils through AAO template. *Materials Chemistry and Physics*, 91(2–3), 518–523.
- Zheng, Y., Li, X., and Dutta, P.K. (2012) Exploitation of unique properties of zeolites in the development of gas sensors. *Sensors*, 12(4), 5170–5194.

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2. Permpool, T.; Sirivat, A.; Aussawasathien, D.; and Wannatong, L. (2013) Polydiphenylamine/zeolite Y composites and electrical conductivity responses toward halogenated hydrocarbons. Materials Research-ibero-American Journal of Materials, 16(5), 1020-1029.
3. Permpool, T.; Sirivat, A.; Aussawasathien, D.; and Wannatong, L. (2013) Development of polydiphenylamine/zeolite Y composite by dealumination process as a sensing material for halogenated solvents. Polymer-Plastics Technology and Engineering, 52, 907-920.

4. Permpool, T.; Sirivat, A.; and Aussawasathien, D. (2014) Synthesis of polydiphenylamine with tunable size and shape via emulsion polymerization. Polymer International, In press.
5. Permpool, T.; Sirivat, A.; and Aussawasathien, D. (2014) Polydiphenylamine/zeolite Y composite as a sensor array for the selection of different chemical vapors. The Journal of Physical Chemistry C, Submitted.

Proceedings:

1. Permpool, T.; Sirivat, A.; and Supaphol, P. (2010, April 22) Electrospun polydiphenylamine-polyethylene oxide as a methanol sensor. Proceedings of the 16th PPC Symposium on Petroleum, Petrochemicals, and Polymers 2010, Bangkok, Thailand.

Presentations:

1. Permpool, T.; Sirivat, A.; and Supaphol, P. (2010, April 22) Electrospun polydiphenylamine-polyethylene oxide as a methanol. Paper presented at the 16th PPC Symposium on Petroleum, Petrochemicals, and Polymers 2010, Bangkok, Thailand. (Poster presentation)
2. Permpool, T.; Aussawasathien, D.; Wannatong, L.; and Sirivat, A. (2011, October 20-21) Electrical conductivity responses of polydiphenylamine/zeolite Y composites to halogenated hydrocarbons. Paper presented at the 2nd Polymer Conference of Thailand, Bangkok, Thailand. (Poster presentation)
3. Permpool, T.; Aussawasathien, D.; Wannatong, L.; and Sirivat, A. (2012, June 10-14) Fabrication of polydiphenylamine and zeolite Y composites as a sensing material. Paper presented at the 4th International Conference Smart Materials Structure Systems, CIMTEC 2012, Montecatini Terme, Tuscany, Italy. (Poster presentation)
4. Permpool, T.; Sirivat, A.; Aussawasathien, D.; and Wannatong, L. (2013, April 22) Dealumination of polydiphenylamine/zeolite Y composite as a sensing material for halogenated solvents. Paper presented at the 1st Annual Symposium of Conductive and Electroactive Polymers, CEAP 2013, Bangkok, Thailand. (Poster presentation)

5. Permpool, T.; Sirivat, A.; and Aussawasathien, D. (2013, June 25-26) Development of polydiphenylamine/zeolite Y composite and electrical conductivity responses toward halogenated hydrocarbons. Paper presented at Third International conference on Electromechanically Active Polymer (EAP) transducers & artificial muscles, EuroEAP 2013, Dubendorf (Zurich), Switzerland. (Oral and Poster presentation)
6. Permpool, T.; Sirivat, A.; and Aussawasathien, D. (2014, April 22) Polydiphenylamine/zeolite Y composites as a sensing material for halogenated solvents. Paper presented at the 5th Research Symposium on Petrochemical and Materials Technology and the 20th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand. (Poster presentation)
7. Permpool, T.; Sirivat, A.; and Aussawasathien, D. (2014, January 24-27) Polydiphenylamine nanoparticle in the effect of surfactant types and concentration. Paper presented at the 14th International Symposium on Biomimetic Materials Processing, BMMP-14, Takayama, Japan. (Poster presentation)
8. Permpool, T.; Sirivat, A.; and Aussawasathien, D. (2014, April 21-25) Electrical conductivity responses of polydiphenylamine/zeolite Y composites toward halogenated hydrocarbons. Paper presented at 2014 MRS Spring Meeting & Exhibit, San Francisco, California, USA. (Poster presentation)