

REFERENCES

- Arroyo, M., López-Manchado, M. A., Valentín, J. L., and Carretero, J. (2007) *Morphology/behaviour relationship of nanocomposites based on natural rubber/epoxidized natural rubber blends*. Compos. Sci. Technol. 67, 1330–1339.
- Ashmore, M. and Hearn, J. (2000) *Flocculation of Model Latex Particles by Chitosans of Varying Degrees of Acetylation*. Langmuir 16, 4906-4911.
- Bradbury, J.H. and Perera, M.C.S. (1988) *Advances in the Epoxidation of Unsaturated Polymers*. Ind. Eng. Chem. Res., 27, 2196-2203.
- Burkert, H., and Hartmann, J. (2003) Flocculants. Ullmann's Encyclopedia of Industrial Chemistry. 6th Editions, 201-212.
- Carvalho, A.J.F., Job, A.E., Alves, N., Curvelo, A.A.S., and Gandini, A. (2003) *Thermoplastic Strach/ Natural Rubber Blends*. Carbohydr. Polym. 53 (1), 95-99.
- Chaikumpollert, O., Rakdee, C., Loykulnant, S., and Suchiva, K. Proceeding.
- Chen, X-G and Park, H-J (2003) *Chemical characteristics of O-carboxymethyl chitosans related to the preparation conditions*. Carbohydr. Polym. 53 (4), 355-359.
- Chen, Z., Mo, X., He, C., and Wang, H. (2008) *Intermolecular interactions in electrospun collagen–chitosan complex nanofibers*. Carbohydr. Polym. 72, 410-418.
- Cho, Y-W., Jang, J., Park, C. R., and Ko, S-W. (2000) *Preparation and Solubility in Acid and Water of Partially Deacetylated Chitins*. Biomacromolecules 1(4), 609-614.
- Divakaran, R.V.N. and Pillai, S. (2001) *Flocculation of Kaolinite Suspensions in Water by Chitosan*. Water Res. 35 (16), 3904-3908.
- Divakaran, R. and Pillai, V.N.S. (2002) *Flocculation of River Silt Using Chitosan*. Water Res. 36, 2414-2418.
- Domard, A., Rinaudo, M., and Terrassin, C. (1986) *New method for the quaternization of chitosan*. Int. J. Biol. Macromol. 8, 105-107.

- Dong, X. M., Revol, J. F., and Gray, D. G. (1998) *Effect of microcrystallite preparation conditions on the formation of colloid crystals of cellulose.* Cellulose, 5 (1), 19-32.
- Dumitriu, S., Popa, M. I., Cringu, A., and Stratone, A. (1989) *Synthesis and characterization of some retard antibiotics.* Colloid. Polym. Sci. 267, 595-599.
- Dung, P. L., Milas, M., Rinaudo M., and Desbrières J. (1994) *Water soluble derivatives obtained by controlled chemical modifications of chitosan.* Carbohyd. Polym. 24 (3), 209-214.
- Dupont, J., Moreau, F., Lance, C., and Jacob, J-L. (1976) *Phospholipid Composition of the Membrane of Lutoids from Hevea Brasiliensis Latex.* Photochem 15, 1215-1217.
- Einbu, A., Naess, S. N., Elgsaeter, A., and Varum, K. M. (2004) *Solution Properties of Chitin in Alkali.* Biomacromolecules 5(5), 2048-2054.
- Greve, H-H (2003) Rubber. Ullmann's Encyclopedia of Industrial Chemistry. 6th Editions, John Wiley & Sons, New York, 447-460.
- Greve, H-H and Threadingham, D. (2003) Rubber. Ullmann's Encyclopedia of Industrial Chemistry. 6th Editions, John Wiley & Sons, New York, 443-446.
- Guibal, E. (2004) *Interactions of Metal Ions with Chitosan-based Sorbents : a Review.* Sep. Purif. Technol. 38, 43-74.
- Hofmann, W. (1989) Rubber Technology Handbook. Hanser Publisher, Munich.
- Huang, Z.M., Zhang, Y.-Z., Kotaki, M., and Ramakrishna, S. (2003). *A review on polymer nanofibers by electrospinning and their applications in nanocomposites.* Composites Science and Technology, 63, 2223-2253.
- Ismail, H., Rozman, H. D., Jaffri, R. M. and Ishak, Z. A. M. (1997) *Oil Palm Wood Flour Reinforced Epoxidized Natural Rubber Composites: The Effect Of Filler Content and Size.* Eur. Polym. J. 33, 1627-1632.
- Johnson, P.S. (2001) Rubber Processing an Introduction. Hanser Publisher, Munich.

- Kendra, D.F. and Hadwiger, L.A. (1984). *Characterization of the Smallest Chitosan Oligomer That is Maximally Antifungal to Fusarium Soloni and Elicits Pisatin Formation in Pisum Sativum*. Experimental Mycology, 8, 276.
- Kurita, K. (2001) *Controlled Functionalization of the Polysaccharide Chitin*. Prog. Polym. Sci. 26, 1921-1971.
- Kvien, I., Tanem, B. S., and Oksman, K. (2005). *Characterization of Cellulose Whiskers and Their Nanocomposites by Atomic Force and Electron Microscopy*. Biomacromolecules. 6, 3160-3165.
- Laue, C. and Hunkeler, D. (2006) *Chitosan-graft-Acrylamide Polyelectrolytes: Synthesis, Flocculation, and Modeling*. J. Appl. Polym. Sci. 102, 885-896.
- Loykulnant, S., Kongkaew, C., Chaikumpollert, O., and Suchiwa, K. (2007) *Efficient Recovery of Skim Natural Rubber*. The 1st Thailand-Japan Rubber Symposium.
- Lu, Y.; Weng, L. and Zhang, L. (2004) *Morphology and Properties of Soy Protein Isolate Thermoplastics Reinforced with Chitin Whiskers*. Biomacromolecules 5, 1046-1051.
- Majeti, N.V. and Kumar, R. (2000) *A Review of Chitin and Chitosan Applications*. React. Funct. Polym. 46, 1-27.
- Min, B-M, Leeb, S. W., Limb, J. N., Youb, Y., Leeb, T. S., Kangc, P. H., and Park, W. H. (2004) *Chitin and Chitosan Nanofibers: Electrospinning of Chitin and Deacetylation of Chitin Nanofibers*. Polymer 45, 7137–7142.
- Mishra, D.K., Tripathy, J., Srivastava, A., Mishra, M.M., Behari, K. (2008) *Graft Copolymer (Chitosan-g-N-Vinyl Formamide): Synthesis and Study of its Properties Like Swelling, Metal Ion Uptake and Flocculation*. Carbohyd. Polym., in press.
- Muzzarelli, R.A.A. (1996) *Chitosan-based Dietary Foods*. Carbohyd. Polym. 29, 309-316.
- Muzzarelli, R.A.A. , Ilari, P., and Petrarulo, M. (1994) *Solubility and Structure of N-carboxymethylchitosan*. Int. J. Biol. Macromol. 16, 177-180.

- Nair, K.G. and Dufresne, A. (2003) *Crab Shell Chitin Whisker Reinforced Natural Rubber Nanocomposites. 1. Processing and Swelling Behavior.* Biomacromolecules 4, 657-665.
- Nair, K.G. and Dufresne, A. (2003) *Crab Shell Chitin Whisker Reinforced Natural Rubber Nanocomposites. 2. Mechanical Behavior.* Biomacromolecules 4, 666-674.
- Nair, K.G. and Dufresne, A. (2003) *Crab Shell Chitin Whisker Reinforced Natural Rubber Nanocomposites. 3. Effect of Chemical Modification of Chitin Whiskers.* Biomacromolecules 4, 1835-1842.
- Nishi, N., Maekita, Y., Nishimura, S.I., Hasegawa, O., and Tokura, S. (1987). *Highly Phosphorylated Derivatives of Chitin, Partially Deacetylated Chitin and Chitosan as New Functional Polymers: Metal Binding Property of the Insolubilized Materials.* International Journal of Biological Macromolecules, 9, 109-114.
- Nishimura, S-I., Kohgo, O., and Kurita, K. (1991) *Chemospecific Manipulations of a Rigid Polysaccharide: Syntheses of Novel Chitosan Derivatives with Excellent Solubility in Common Organic Solvents by Regioselective Chemical Modifications.* Macromolecules 24, 4745-4748.
- Paillet, M. and Dufresne, A. (2001) *Chitin Whisker Reinforced Thermoplastic Nanocomposite.* Macromolecules 34 (19), 6527-6530.
- Peniche-covas, C., Alvarez, L. W., and Arguelles-monal, W. (1987) *The adsorption of mercuric ions by chitosan.* J. Appl. Polym. Sci. 46, 1147.
- Pinotti, A., Bevilacqua, A., and Zaritzky, N. (1997) *Optimization of the Flocculation Stage in a Model System of a Food Emulsion Waste using Chitosan as Polyelectrolyte.* J. Food. Eng. 32, 68-81.
- Phongying, S., Aiba, S-I., and Chirachanchai, S. (2007) *Direct Chitosan Nanoscaffold Formation via Chitin Whiskers.* Polymer, 48, 393-400.
- Rao, S. B. and Sharma, C. P. (1997) *Use of Chitosan as a Biomaterial: Studies on Its Safety and Hemostatic Potential.* J. Biomed. Mater. Res. 34, 21-28.
- Richardson, S. C. W., Kolbe, H. V. J., and Duncan, R. (1999) *Potential of Low Molecular Mass Chitosan as a DNA Delivery System: Biocompatibility,*

- Body Distribution and Ability to Complex and Protect DNA.* Int. J. Pharm. 178, 231-243.
- Rinaudo, M. (2006) *Chitin and Chitosan: Properties and Application.* Prog. Polym. Sci. 31 (7), 603-632.
- Roussy, J. and Guibal, E. (2007) *Coagulation and Flocculation of Dye-containing Solutions Using a Biopolymer (Chitosan).* React. Funct. Polym. 67, 33–42.
- Shatalov, G.V., Verezhnikov, V.N., Churilina, E.V., Kuznetsov, V.A., and Poyarkova, T.N. (2003) *Flocculation of a Synthetic Rubber Latex with Homopolymers and Copolymers of N-Vinylcaprolacta and N-Vinylimidazoles.* Russ. J. Appl. Chem. 76(11), 1839-1843.
- Shen, J-J, Ren, L-L., and Zhuang, Y-Y (2006) *Interaction Between Anionic Dyes and Cationic Flocculant P(AM-DMC) in Synthetic Solutions.* J. Hazard. Mater. 136(3), 809–815.
- Sugimoto, M., Morimoto, M., Sashiwa, H., Saimoto, H. and Shigemasa, Y. (1998) *Preparation and Characterization of Water-Soluble Chitin and Chitosan Derivatives.* Carbohyd. Polym. 36(1), 49-59.
- Teh, P.L., Ishak, Z.A.M., Hashim, A.S., Karger-Kocsis, J., and Ishiaku, U.S. (2004) *Effects of Epoxidized Natural Rubber as a Compatibilizer in Melt Compounded Natural Rubber–organoclay Nanocomposites.* Eur. Polym. J. 40, 2513-2521.
- Verezhnikov, V.N., Mińkova, T.V., and Poyarkova, T.N. (2004) *Flocculation of Butadiene-Styrene Latex with Polymeric Ammonium Salts of N,N-Dimethylaminoethyl Methacrylate and Mineral Acids.* Russ. J. Appl. Chem. 77(5), 830-834.
- Verezhnikov, V.N., Mińkova, T.V., and Poyarkova, T.N. (2005) *Interaction of a Cationic Polymeric Flocculant with Anionic Stabilizers in Latex.* Russ. J. Appl. Chem. 78(7), 1154-1157.
- Verezhnikov, V.N., Nikulin, S.S., Poyarkova, T.N., and Misin, V.M. (2001) *Seperation of Styrene-Butadiene Rubbers from Latexes Using Dimethyldiallylammonium Chloride-SO₂ Copolymer.* Russ. J. Appl. Chem. 74(7), 1225-1229.

- Verezhnikov, V.N., Nikulin, S.S., Poyarkova, T.N., and Vostrikova, Y.G. (2002) *Flocculating Power of Poly-N,N-dimethyl-N,N-diallylammonium Chloride of Various Molecular Weights*. Russ. J. Appl. Chem. 75(3), 461-464.
- Wang, J-P., Chen, Y-Z., Zhang, S-J., and Yu, H-Q. (2008) *A Chitosan-based Flocculant Prepared with Gamma-Irradiation-Induced Grafting*. Bioresource. Technol. 99, 3397-3402.
- www.snf-group.com/Flocculants.html
- Yew, G.H., Yusof, A.M.M., Ishak, Z.A.M., and Ishiaku, U.S. (2005) *Water Absorption and Enzymatic Degradation of Poly(lactic acid)/rice starch Composites*. Polym. Degrad. Stabil 90, 488-500.
- Zeng, D., Wu, J., Kennedy J. F. (2008) *Application of a Chitosan Flocculant to Water Treatment*. Carbohydr. Polym. 71, 135-139.
- Zurina, M., Ismail, H., and Ratnam, C. T. (2006) *Characterization of Irradiation-induced Crosslink of Epoxidised Natural Rubber/Ethylene vinyl acetate (ENR-50/EVA) Blend*. Polym. Degrad. Stabil. 91, 2723-2730.

CURRICULUM VITAE



Name: Ms. Tipparat Lertwattanaseri

Date of Birth: November 24, 1981

Nationality: Thai

University Education:

1999-2002 Bachelor Degree of Science, Department of Material Science,
Faculty of Science, Chulalongkorn University, Bangkok,
Thailand.

Awards/Honors:

Half scholarship from SRI R&D Ltd. and The Petroleum and Petrochemical College for Ph.D. Program.

Publications:

1. Lertwattanaseri, T., Ichikawa, N., Mizoguchi, T., Tanaka, Y., and Chirachanchai, S.* "Epoxidized Natural Rubber Bio-Nanocomposites: A Model Case of Bio-nanocomposite using Nanofibrous Chitosan and Its Consequent Functional Properties", Chem Lett, 2009, 38(8), 798-799.
2. Lertwattanaseri, T., Ichikawa, N., Mizoguchi, T., Tanaka, Y., and Chirachanchai, S.*, "Microwave Technique for Efficient Deacetylation of Chitin Nanowhisker to Chitosan Nanoscaffold", Carbohydr Res, 2009, 344, 331-335.
3. Lertwattanaseri, T., Ichikawa, N., Mizoguchi, T., Tanaka, Y., and Chirachanchai, S.*, "Water-Soluble Chitin-Chitosan Derivatives and Their Applications on a Rubber Flocculant". J Appl Polym Sci, In preparation.
4. Lertwattanaseri, T., Ichikawa, N., Mizoguchi, T., Tanaka, Y., and Chirachanchai, S.*, "Bio-Nanocomposite System of Nano-Chitosan in Epoxidized Natural Rubber", Langmuir, In preparation.

Patents:

1. Phongying, S., Lertwattanaseri, T., and Chirachanchai, S.*, "Chitosan Nanoscaffold", Thai Patent Application, Patent pending.
2. Yoji Imoto, Naoya Ichikawa, Suwabun Chirachanchai, and Tipparat Lertwattanaseri. "Rubber Composition, Manufacturing Method for Same and Pneumatic Tire", Sumitomo Rubber Industries and Chulalongkorn University, Patent, Patent pending.

Proceedings:

1. Lertwattanaseri, T. and Chirachanchai, S.*, "Chitosan Nanoscaffold Biofiller: The Preparation by Microwave Technique", 232nd American Chemical Society National Meeting & Exposition, San Francisco, USA, September 10-14, 2006. (Proceeding in press).
2. Naoya Ichikawa, Tipparat Lertwattanaseri, Suwabun Chirachanchai*, Yoji Imoto, Tetuo Mizoguchi, and Yasuyuki Tanaka, "Nano-Biofiller for Rubber", Proceeding of the 2nd ICAPP, 2007, Bangkok, Thailand.
3. Lertwattanaseri, T., Ichikawa, N., and Chirachanchai, S.*, "Application of Chitosan Derivatives for Natural Rubber Flocculant", Japan Rubber Symposium 2006, Kyoto University, Kyoto, Japan, May 18, 2006, 63.

Presentations:

1. Tipparat Lertwattanaseri, Suwabun Chirachanchai*, Naoya Ichikawa, Tetuo Mizoguchi, Yoji Imoto and Yasuyuki Tanaka, "Nano-Biofiller for Rubber Application", Chemical Nanotechnology Talk VIII, Frankfurt, Germany, November 20-21, 2007.
2. Naoya Ichikawa, Tipparat Lertwattanaseri, Suwabun Chirachanchai*, Yoji Imoto, Tetuo Mizoguchi, and Yasuyuki Tanaka, "Nano-Biofiller for Rubber", The 2nd ICAPP, Bangkok, Thailand, 25-28 June 2007.
3. Naoya Ichikawa, Tipparat Lertwattanaseri, Suwabun Chirachanchai and Yoji Imoto, Properties of Natural Rubber Coagulated with Modified Chitosan, 15th Polymer Material Forum, Osaka, Japan, November 16 - 17, 2006.

4. Lertwattanaseri, T. and Chirachanchai, S.*, “Chitosan Nanoscaffold Biofiller: The Preparation by Microwave Technique”, 232nd American Chemical Society National Meeting & Exposition, San Francisco, USA, September 10-14, 2006.
5. Lertwattanaseri, T., Ichikawa, N., and Chirachanchai, S.*, “Application of Chitosan Derivatives for Natural Rubber Flocculant”, Japan Rubber Symposium 2006, Kyoto University, Kyoto, Japan, May 18, 2006.

