Professor Ian Norton BA, DPhil, FRSC, FIChemE, FSB, CChem, CEng

Professor of Chemical Engineering

School of Chemical Engineering (/schools/chemical-engineering/index.aspx)

Contact details

Telephone +44 (0) 121 414 5296 (tel:+44 121 414 5296)

Email i.t.norton@bham.ac.uk (mailto:i.t.norton@bham.ac.uk)

School of Chemical Engineering
University of Birmingham
Edgbaston
Birmingham
B15 2TT
UK

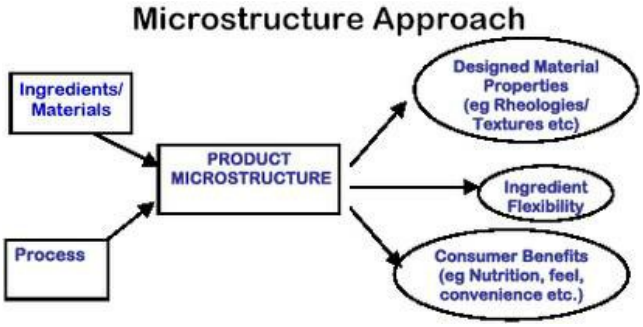
Qualifications

- BA Chemistry, University of York, 1977
- DPhil in Fast Reaction Kinetics of Conformational Transitions in Polysaccharides. University of York, 1980

Research

Prof Norton has recently left his role as Chief Scientist at Unilever to take a Chair as Professor of Soft Solid Microstructural Engineering in the Department of Chemical Engineering. Prof Norton doctorate was in the Physical Chemistry of polysaccharide conformational transitions were he focused on fast reaction kinetics and thermodynamics.

Once he joined industry he moved into the area of colloids and interfaces and developed a microstructure approach. This approach is were the material properties are designed by choosing the ingredients and the way they physically interact and then designing the process to physically structure and trap the microstructure in the desired state, see figure.



The material thus produced determines the material properties, can allow ingredient flexibility in terms of alternatives and replacement, and impact on consumer response ranging from what they are eating, their nutrition and health to what they use to clean their homes or groom themselves.

Professor Norton used this approach to design foods and home and personal care products for Unilever, resulting in a large number of new inventions (he is an inventor on more than 60 granted patents) leading to many new and innovative products, which are still sold today. In his new role at the University Professor Norton will continue this work and extend to a wider range of soft solids. Soft solids are used extensively in: Foods, Personal Care Products, Cosmetics, Paints, Pharmaceuticals, Home Care / Hard Surface cleaning and Laundry.

Professor Norton has authored more than 100 original refereed papers on the science and engineering of biopolymers, fat physical chemistry, kinetics, emulsions, rheology and material science and is an inventor on more than 60 granted patents covering ingredients, spreads, dressings, sauces, skin creams, shampoos and ice-cream.

Current research interests:

- Emulsions/Emulsification
- Interfacial design - chemical composition, material properties and rheology
- Biopolymer solutions and gels - single systems and mixtures, processing control of structures
- Physical chemical aspects of nutrition and health - in particular how food microstructure can be used to impact on food consumption and the dynamics of macronutrient release
- Encapsulation and release - targeted delivery
- Colloids at surfaces and bio-surfaces
- Crystallisation / Control of crystal morphology and networks - by the chemistry and the processes
- Material properties of soft solids (including rheology and fracture and flow)
- In use properties - oral processing, skin applications, cooking, surface behaviour etc

Publications

Recent Publications and Patents.

1. Lloyd, D.M., I.T. Norton, and F. Spyropoulos, *Processing effects during rotating membrane emulsification.*Journal of Membrane Science, 2014. **466**(0): p. 8-17.
2. Lee, L., et al., *Production of water-in-oil nanoemulsions using high pressure homogenisation: A study on droplet break-up.*Journal of Food Engineering, 2014. **131**: p. 33-37.
3. Fernández Farrés, I. and I.T. Norton, *Formation kinetics and rheology of alginate fluid gels produced by in-situ calcium release.*Food Hydrocolloids, 2014. **40**(0): p. 76-84.
4. Douaire, M., et al., *Fat crystallisation at oil-water interfaces.*Advances in Colloid and Interface Science, 2014. **203**: p. 1-10.
5. di Bari, V., J.E. Norton, and I.T. Norton, *Effect of processing on the microstructural properties of water-in-cocoa butter emulsions.*Journal of Food Engineering, 2014. **122**(0): p. 8-14.

6. Cooper, C., et al., *The acoustics of friction and microstructure of model and apparel fabrics.*Textile Research Journal, 2014. **84**(6): p. 626-637.

7. Bradbeer, J.F., et al., *Self-structuring foods based on acid-sensitive low and high acyl mixed gellan systems to impact on satiety.*Food Hydrocolloids, 2014. **35**(0): p. 522-530.

8. Beri, A., R. Pichot, and I.T. Norton, *Physical and material properties of an emulsion-based lipstick produced via a continuous process.*International Journal of Cosmetic Science, 2014. **36**(2): p. 148-158.

9. Pichot, R., R.L. Watson, and I.T. Norton, *Phospholipids at the interface: current trends and challenges.*Int J Mol Sci, 2013. **14**(6): p. 11767-94.

10. Pawlik, A.K. and I.T. Norton, *Bridging benchtop research and industrial processed foods: Structuring of model food emulsions.*Food Structure, 2013(0).

11. Pawlik, A.K. and I.T. Norton, *SPG rotating membrane technique for production of food grade emulsions.*Journal of Food Engineering, 2013. **114**(4): p. 530-537.

12. Norton, J.E., P. Fryer, and I.T. Norton, *Formulation Engineering of Foods*. 2013: Wiley.

13. Niknafs, N., R.D. Hancocks, and I.T. Norton, *Measurement Techniques Applicable to the Investigation of Emulsion Formation during Processing*, in *Emulsion Formation and Stability*. 2013, Wiley-VCH Verlag GmbH & Co. KGaA. p. 109-126.

14. Mills, T., I.T. Norton, and S. Bakalis, *Development of tribology equipment to study dynamic processes.*Journal of Food Engineering, 2013. **114**(3): p. 384-390.

15. Mills, T. and I. Norton, *Salt Reduction in Food*, in *Formulation Engineering of Foods*. 2013. p. 163.

16. Mills, T., A. Koay, and I.T. Norton, *Fluid gel lubrication as a function of solvent quality.*Food Hydrocolloids, 2013. **32**(1): p. 172-177.

17. Lee, L.L., et al., *Emulsification: Mechanistic understanding.*Trends in Food Science & Technology, 2013. **31**(1): p. 72-78.

18. Lee, L. and I.T. Norton, *Comparing droplet breakup for a high-pressure valve homogeniser and a Microfluidizer for the potential production of food-grade nanoemulsions.*Journal of Food Engineering, 2013. **114**(2): p. 158-163.

19. Le Reverend, B.J., I.T. Norton, and S. Bakalis, *Modelling the human response to saltiness.*Food Funct, 2013. **4**(6): p. 880-8.

20. Kurukji, D., et al., *Interfacial behaviour of sodium stearoyllactylate (SSL) as an oil-in-water pickering emulsion stabiliser.*J Colloid Interface Sci, 2013. **409**(0): p. 88-97.

21. Ingram, J.S.I., et al., *Priority research questions for the UK food system.*Food Security, 2013. **5**(5): p. 617-636.

22. Hancocks, R.D., F. Spyropoulos, and I.T. Norton, *Comparisons between membranes for use in cross flow membrane emulsification.*Journal of Food Engineering, 2013. **116**(2): p. 382-389.

23. Garrec, D.A. and I.T. Norton, *Kappa carrageenan fluid gel material properties. Part 2: Tribology.*Food Hydrocolloids, 2013. **33**(1): p. 160-167.

24. Garrec, D.A., B. Guthrie, and I.T. Norton, *Kappa carrageenan fluid gel material properties. Part 1: Rheology.*Food Hydrocolloids, 2013. **33**(1): p. 151-159.

25. Fernández Farrés, I., M. Douaire, and I.T. Norton, *Rheology and tribological properties of Ca-alginate fluid gels produced by diffusion-controlled method.*Food Hydrocolloids, 2013. **32**(1): p. 115-122.

26. Beri, A., J.E. Norton, and I.T. Norton, *Effect of emulsifier type and concentration, aqueous phase volume and wax ratio on physical, material and mechanical properties of water in oil lipsticks.*International Journal of Cosmetic Science, 2013. **35**(6): p. 613-621.

27. Siddiqui, S.W. and I.T. Norton, *Oil-in-water emulsification using confined impinging jets.*J Colloid Interface Sci, 2012. **377**(1): p. 213-21.

28. Pichot, R., F. Spyropoulos, and I.T. Norton, *Competitive adsorption of surfactants and hydrophilic silica particles at the oil-water interface: interfacial tension and contact angle studies.*J Colloid Interface Sci, 2012. **377**(1): p. 396-405.

29. Pawlik, A.K. and I.T. Norton, *Encapsulation stability of duplex emulsions prepared with SPG cross-flow membrane, SPG rotating membrane and rotor-stator techniques—A comparison.*Journal of Membrane Science, 2012. **415-416**(0): p. 459-468.

30. Kargar, M., et al., *Investigation into the potential ability of Pickering emulsions (food-grade particles) to enhance the oxidative stability of oil-in-water emulsions.*J Colloid Interface Sci, 2012. **366**(1): p. 209-15.

31. Garrec, D.A. and I.T. Norton, *ON THE LUBRICATING BEHAVIOUR OF KAPPA CARRAGEENAN GELLED NETWORKS*, in *Gums and Stabilisers for the Food Industry 16*, P.A. Williams and G.O. Phillips, Editors. 2012, Royal Soc Chemistry: Cambridge. p. 183-190.

32. Garrec, D.A. and I.T. Norton, *Boundary lubrication by sodium salts: a Hofmeister series effect.*J Colloid Interface Sci, 2012. **379**(1): p. 33-40.

33. Garrec, D.A. and I.T. Norton, *Understanding fluid gel formation and properties.*Journal of Food Engineering, 2012. **112**(3): p. 175-182.

34. Garrec, D.A. and I.T. Norton, *The influence of hydrocolloid hydrodynamics on lubrication.*Food Hydrocolloids, 2012. **26**(2): p. 389-397.

35. Garrec, D.A., et al., *Designing colloidal structures for micro and macro nutrient content and release in foods.*Faraday Discuss, 2012. **158**(0): p. 37-49; discussion 105-24.

36. Vardhanabhuti, B., et al., *Lubricating properties of human whole saliva as affected by beta-lactoglobulin.*Food Hydrocolloids, 2011. **25**(6): p. 1499-1506.

37. Tchuenbou-Magaia, F.L., et al., *Suspensions of air cells with cysteine-rich protein coats: Air-filled emulsions.*Journal of Cellular Plastics, 2011. **47**(3): p. 217-232.

38. Spyropoulos, F., A.B. Norton, and I.T. Norton, *Self-structuring foods based on acid-sensitive mixed biopolymer to impact on satiety.*11th International Congress on Engineering and Food (Icef11), 2011. **1**(0): p. 1487-1493.

39. Spyropoulos, F., R.D. Hancocks, and I.T. Norton, *Food-grade emulsions prepared by membrane emulsification techniques.*11th International Congress on Engineering and Food (Icef11), 2011. **1**(0): p. 920-926.

40. Spyropoulos, F., S. Frasch-Melnik, and I.T. Norton, *W/O/W emulsions stabilized by fat crystals - Their formulation, stability and ability to retain salt.*11th International Congress on Engineering and Food (Icef11), 2011. **1**(0): p. 1700-1708.

41. Norton, I.T., et al., *Rheological Control and Understanding Necessary to Formulate Healthy Everyday Foods*, in *Practical Food Rheology*. 2011, Wiley-Blackwell. p. 219-253.

42. Niknafs, N., F. Spyropoulos, and I.T. Norton, *Development of a new reflectance technique to investigate the mechanism of emulsification.*Journal of Food Engineering, 2011. **104**(4): p. 603-611.

43. Mills, T., et al., *Development of an in-vitro mouth model to quantify salt release from gels.*Food Hydrocolloids, 2011. **25**(1): p. 107-113.

44. Le Révérend, B.J.D., I. Norton, and S. Bakalis, *Modelling of In-Mouth Perception the Case of Sodium.*Procedia Food Science, 2011. **1**(0): p. 1152-1157.

45. Le Reverend, B.J., M.S. Taylor, and I.T. Norton, *Design and application of water-in-oil emulsions for use in lipstick formulations.*Int J Cosmet Sci, 2011. **33**(3): p. 263-8.

46. Kargar, M., F. Spyropoulos, and I.T. Norton, *Microstructural design to reduce lipid oxidation in oil-inwater emulsions.*Procedia Food Science, 2011. **1**(0): p. 104-108.

47. Kargar, M., F. Spyropoulos, and I.T. Norton, *The effect of interfacial microstructure on the lipid oxidation stability of oil-in-water emulsions.*J Colloid Interface Sci, 2011. **357**(2): p. 527-33.

48. Tharakan, A., et al., *Mass transfer and nutrient absorption in a simulated model of small intestine.*J Food Sci, 2010. **75**(6): p. E339-46.

49. Tchuenbou-Magaia, F.L., I.T. Norton, and P.W. Cox, *MICROBUBBLES WITH PROTEIN COATS FOR HEALTHY FOOD AIR FILLED EMULSIONS*. Gums and Stabilisers for the Food Industry 15, ed. P.A. Williams and G.O. Phillips. 2010, Cambridge: Royal Soc Chemistry. 113-125.

50. Spyropoulos, F., A. Portsch, and I.T. Norton, *Effect of sucrose on the phase and flow behaviour of polysaccharide/protein aqueous two-phase systems.*Food Hydrocolloids, 2010. **24**(2-3): p. 217-226.

51. Portsch, A., F. Spyropoulos, and I.T. Norton, *PHASE EQULIBRIA AND RHEOLOGICAL BEHAVIOUR OF POLYSACCHARIDE-PROTEIN AQUEOUS SOLUTIONS WITH SUGAR*. Gums and Stabilisers for the Food Industry 15, ed. P.A. Williams and G.O. Phillips. 2010, Cambridge: Royal Soc Chemistry. 239-246.

52. Pichot, R., F. Spyropoulos, and I.T. Norton, *O/W emulsions stabilised by both low molecular weight surfactants and colloidal particles: The effect of surfactant type and concentration.*J Colloid Interface Sci, 2010. **352**(1): p. 128-35.

53. Pawlik, A., P.W. Cox, and I.T. Norton, *Food grade duplex emulsions designed and stabilised with different osmotic pressures.*J Colloid Interface Sci, 2010. **352**(1): p. 59-67.

54. Norton, J.E. and I.T. Norton, *Designer colloids—towards healthy everyday foods?*Soft Matter, 2010. **6**(16): p. 3735.

55. Le Révérend, B.J.D., et al., *Colloidal aspects of eating.*Current Opinion in Colloid & Interface Science, 2010. **15**(1-2): p. 84-89.

56. Henry, J.V.L., et al., *The influence of phospholipids and food proteins on the size and stability of model sub-micron emulsions.*Food Hydrocolloids, 2010. **24**(1): p. 66-71.

57. Gabriele, A., F. Spyropoulos, and I.T. Norton, *A conceptual model for fluid gel lubrication.*Soft Matter, 2010. **6**(17): p. 4205-4213.

58. Frasch-Melnik, S., F. Spyropoulos, and I.T. Norton, *W1/O/W2 double emulsions stabilised by fat crystals--formulation, stability and salt release.*J Colloid Interface Sci, 2010. **350**(1): p. 178-85.

59. Frasch-Melnik, S., I.T. Norton, and F. Spyropoulos, *Fat-crystal stabilised w/o emulsions for controlled salt release.*Journal of Food Engineering, 2010. **98**(4): p. 437-442.

60. de Celis Alonso, B., et al., *NMR relaxometry and rheology of ionic and acid alginate gels.*Carbohydrate Polymers, 2010. **82**(3): p. 663-669.

61. Brown, Z.K., et al., *Drying of agar gels using supercritical carbon dioxide.*Journal of Supercritical Fluids, 2010. **54**(1): p. 89-95.

62. Bakalis, S., et al., *MODELLING OF PHYSICAL PROCESSES IN THE SMALL INTESTINE*. Gums and Stabilisers for the Food Industry 15, ed. P.A. Williams and G.O. Phillips. 2010, Cambridge: Royal Soc Chemistry. 377-383

Recent Book Chapters

1. Spyropoulos, F., Cox, P.W. & Norton, I.T. Immiscible liquid – liquid mixing. in FOOD MIXING - PRINCIPLES AND APPLICATIONS (ed. P.J.Cullen) (blackwell publishing, 2009).
2. Foster, T.J. & Norton, I.T. Self-assembling structures in the GI tract. in Designing functional foods (eds. McClements, D.J. & Decker, E.) (Woodhead, 2009).
3. Cox, P.W., Spyropoulos, F. & Norton, I.T. Effect of Processing on Biopolymer Interactions. in Modern Biopolymer Science: Bridging the Divide between Fundamental Treatise and Industrial Application (eds. Kasapas, S., Norton, I.T. & J.Ubbink) (Elsevier, 2009).
4. Seville, J.P.K., Fryer, P.J. & Norton, I.T. Formulation of Structured Chemical Products. in Product Design and Engineering, Vol. 2 (eds. Brockel, U., Meier, W. & Wagner, G.) 701 - 713 (2007).
5. Seville, J.P.K., Fryer, P.J. & Norton, I.T. Formulation of Structured Chemical Products. in Product Design and Engineering, Vol. 1 (eds. Brockel, U., Meier, W. & Wagner, G.) 121 - 129 (2007).

Selected Granted Patents

1. Frith W.J., Norton I.T., and Wolf B., 'Fibre containing composition', no. EP1285588, (2003).
2. Appelquist I.A.M., Brown C.R.T., Homan J.E., Jones M.G., Malone M.E., and Norton I.T., 'Low-fat food emulsions having controlled flavour release and processes therefor', no. EP1102548, (2001).
3. Aronson M.P., Brown C.R.T., Chatfield R.J., Fairley P., Norton I.T., and Williams J.R., 'Detergent compositions', no. EP1066366, (2001).
4. Aldred A., Appelqvist I.A.M., Brown C.R.T., Homan J.E., Jones M.G., Malone M.E., Norton I.T., and Underdown J., 'Frozen low-fat food emulsions and processes therefor', no. EP1102544, (2001).
5. Bialek J.M., Jones M.G., and Norton I.T., 'Pourable edible aqueous-continuous emulsions', no. EP0994658, (2000).
6. Grant E., Campbell I, Norton I., inventor. 'Stable coconut cream alternative', no. WO9819553, (1998).
7. Brown C.R.T., Jones M.G., Norton I.T., and Underdown J., 'Aqueous dispersions with hydrolysed starch derivatives', no. WO9713413, (1997).
8. Brown C.R.T., Daniels S.C., Jones M.G., Norton I.T., Rubow R.E., Kochakji D.J., and Buchanan M.A., 'Pourable salad dressing', no. EP0771151, (1997).
9. Appelqvist I.A.M., Brown C.R.T., and Norton I.T., 'Liquid sauce or soup', no. EP0772406, (1997).
10. Norton I.T. and Underdown J., 'Low fat spread', no. EP0753996, (1997).
11. Livingston R.M. and Norton I.T., 'Edible spread with aqueous phase with non-gelling thickener system and low protein content', no. US5656322, (1997).
12. Norton I.T., Kelly T.R., and Underdown J., 'Spread', no. EP0420315, (1991).
13. Norton I.T., 'Water-in-oil dispersion and process for preparing such dispersion', no. EP0398412, (1990).
14. Cain F.W., Day M.J.I., Jones M.G., and Norton I.T., 'Edible plastified dispersion', no. EP0279499, (1988).

© University of Birmingham 2014