

NAME AND CONTACT DETAILS	
Name:	Professor Brian Glennon
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CAREER PROFILE	
Education	
PhD (1992)	Chemical Engineering, UCD
BE (1986)	Chemical Engineering, UCD
Employment	
2014 -	Professor of Chemical and Bioprocess Engineering, UCD
2007 - 2014	Associate Professor, UCD
2004 - 2007	Senior Lecturer, UCD
1995 – 2004	Lecturer, School of Chemical & Bioprocess Engineering, UCD
1992 – 1995	Chemical Engineering, Merck Sharp & Dohme, Co Tipperary

INNOVATION/COMMERCIALISATION ACTIVITY	
<p>Industrial Collaborations: As part of SSPC activities, I have collaborated with Pfizer, Merck, Lilly, Janssen, Roche, Helsinn, Clarochem. As part of the EI-funded research I have collaborated with Pfizer, Lilly, ABB, Janssen.</p>	
<p>Spin Out Activities: APC Ltd was founded in 2011 by Professor Brian Glennon and Dr Mark Barrett. Since its formation, the company has grown to one of the largest biopharmaceutical process development companies in Ireland, with over 100 full-time employees, 80% of whom are qualified at PhD-level. APC collaborates with 8 of the top 10 global pharmaceutical companies and 5 of the top 10 global biotech companies on process research and development. APC is one of the largest employers of SFI-trained researchers, and the largest employer in Ireland of PhD-qualified Chemical Engineers. Professor Glennon acts as a part-time technical advisor to the company.</p>	

KEY ACHIEVEMENTS (RESEARCH AND IMPACT)	
<p>1. Formation of APC, Ltd. Founded in 2011 by B. Glennon and M. Barrett, APC Ltd has grown steadily to be now one of the largest biopharmaceutical process development companies in Ireland, with over 100 full-time employees, 80% of whom are qualified at PhD-level. APC is one of the largest employers of SFI-trained researchers and the largest employer in Ireland of PhD-qualified Chemical Engineers. Over 80% of the company's projects are export-driven, delivering major returns to the Irish exchequer. B. Glennon continues to act as a part-time technical advisor to the company.</p>	
<p>2. Application of PAT for the automated measurement of solubility. The paper "Characterizing the metastable zone width and solubility curve using Lasentec FBRM and PVM", by P. Barrett and B. Glennon, published in <i>Chemical Engineering Research and Design: Transaction of the Institution of Chemical Engineers Part A</i> in 1999,</p>	

established the standard approach for the automated polythermal measurement of the solubility of crystalline solids in liquid solvents using the FBRM PAT method. The paper is still regularly cited as the definitive description of the method. This work was completed as part of an Enterprise Ireland funded project into PAT applications in crystallization research. The first author was a PhD student working on the project. The work was the first in a long line of papers which demonstrated the application of Process Analytical Technologies to the understanding of industrial crystallization. Subsequent publications focused on the use of mid-IR and Raman spectroscopy as important techniques for in-process application.

3. Development of a scale-up strategy for anti-solvent crystallizations.

The paper "The role of meso-mixing in antisolvent crystallization processes", by M. Barrett, D. O'Grady, E. Casey & B. Glennon, published in *Chemical Engineering Science* in 2011, provided a detailed investigation into the role of meso-mixing in the performance of anti-solvent crystallization. Combining Computational Fluid Dynamics with extensive lab- and pilot-scale experimentation, the paper outlined a scale-up approach for anti-solvent crystallization processes. Since its publication, we have successfully applied this meso-mixing based approach to dozens of industrial API anti-solvent crystallizations to facilitate higher consistent scale-up from 1 L scale up to 20,000 L scale without recourse to pilot trials. The approach continues to be used on a regular basis as part of the process development services provided by APC Ltd. This work was completed as part of the SFI-funded Strategic Research Cluster, SSPC, which funded the senior author.

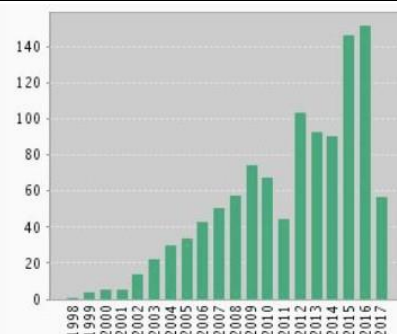
4. Demonstration of pat-enabled model predictive control for cell culture bioprocesses.

The group of papers "Glucose concentration control of a fed-batch mammalian cell bioprocess using a nonlinear model predictive controller" by J. Whelan, S. Craven & B. Glennon, published in *Journal of Process Control* in 2014, "Process Model Comparison and Transferability across Bioreactor Scales and Modes of Operation for a Mammalian Cell Bioprocess" by J. Whelan, S. Craven, N. Shirsat & B. Glennon, published in *Biotechnology Progress* in 2012, and "In Situ Raman Spectroscopy for Simultaneous Monitoring of Multiple Process Parameters in Mammalian Cell Culture Bioreactors" by J. Whelan, S. Craven & B. Glennon, published in *Biotechnology Progress* in 2012, provided the first published, comprehensive demonstration of the application of PAT-enabled model predictive control for a cell culture bioreactor. The process was fully demonstrated on a DCS-based control platform. This work continues to be the benchmark for other groups seeking to emulate this achievement. The work was funded by Enterprise Ireland as part of its Industry-Led Research Programme. The project title was Bioprocess Applications of Process Analytical Technology. The project, led by the senior author, included research groups from NIBRT, DCU and UCC. This work also contributed significantly to the formation of APC Ltd. as part of the project's commercialization focus.

5. Development of platforms for the implementation of continuous crystallization of APIs.

As part of the SFI-funded Strategic Research Cluster, SSPC, the senior author received substantial funding to establish a research programme focused on continuous crystallization of APIs. In collaboration with UL, and supported by Pfizer, Merck, Janssen, Roche and Lilly, this research established experimental framework for the design and optimization of API crystallization processes. This work has provided the principal framework for subsequent continuous processing research in the SSPC.

PUBLICATIONS					
Total No. of Publications: 52	Senior Author Publications: 46	h-Index: 20	Total no. of citations: 1081	Source of citation data: Web of Knowledge	
Journal Articles: 45	Reviews: 4	Book Chapters: 3	Books: 0	Conference associated publications: 0	Other: 0



Selected senior author publications (* Senior author publications) source: Web of Science

1. G. Tully, G. Hou & **B. Glennon***, 'Solubility of Benzoic Acid and Aspirin in Pure Solvents Using Focused Beam Reflective Measurement', *J. Chemical & Engineering Data*, **61** (1), 594-601, 2016. DOI: 10.1021/acs.jced.5b00746 (IF = 1.84)
2. G. Morris, G. Power, S. Ferguson, M. Barrett, G. Hou & **B. Glennon***, 'Estimation of Nucleation and Growth Kinetics of Benzoic Acid by Population Balance Modelling of a Continuous Cooling Mixed Suspension, Mixed Product Removal (MSMPR) Crystallizer', *Organic Process Research & Development*, **19** (12) 1891-1902, 2015. DOI: 10.1021/acs.oprd.5b00139. (IF = 2.92)
3. W. Su, C.L. Li, H.X. Hao, J. Whelan, M. Barrett & **B. Glennon***, 'Monitoring the liquid phase concentration by Raman spectroscopy in a polymorphic system', *J. Raman Spectroscopy*, **46** (11) 1150-1156 2015. DOI: 10.1002/jrs.4745. (IF = 2.40)
4. Y. Zhao, V.K. Kamaraju, G. Hou, G. Power, P. Donnellan & **B. Glennon***, 'Kinetic identification and experimental validation of continuous plug flow crystallisation', *Chemical Engineering Science*, **133**, 106-115, 2015. DOI: 10.1016/j.ces.2015.02.019. (IF = 2.75).
5. G. Power, G. Hou, V.K. Kamaraju, G. Morris, Y. Zhao & **B. Glennon***, 'Design and optimization of a multistage continuous cooling mixed suspension, mixed product removal crystallizer', *Chemical Engineering Science*, **133**, 125-139, 2015. doi: 10.1016/j.ces.2015.02.014. (IF = 2.75).
6. S. Ferguson, G. Morris, H. Hao, M. Barrett & **B. Glennon***, 'Automated self-seeding of batch crystallizations via plug flow seed generation', *Chemical Engineering Research & Design* **92** (11), 2534-2541, November 2014. DOI: 10.1016/j.cherd.2014.01.028. (IF = 2.53).

7. . Craven, J. Whelan & B. Glennon*, 'Glucose concentration control of a fed-batch mammalian cell bioprocess using a nonlinear model predictive controller', *Journal of Process Control*, **24** (4), 344-357, 2014 (IF = 2.22).
8. S. Ferguson, G. Morris, H. Hao, M. Barrett & B. Glennon*, 'Characterization of the anti-solvent batch, plug flow and MSMPR crystallization of benzoic acid', *Chemical Engineering Science*, **104**, 44-54, 2013. (IF = 2.75).
9. D. Duffy, M. Barrett & B. Glennon*, 'Novel, Calibration-Free Strategies for Supersaturation Control in Antisolvent Crystallization Processes', *Crystal Growth and Design*, **13** (8), 3321-3332, 2013. (IF = 4.43).
10. J. Whelan, S. Craven, N. Shirsat & B. Glennon*, 'Process Model Comparison and Transferability across Bioreactor Scales and Modes of Operation for a Mammalian Cell Bioprocess', *Biotechnology Progress*, **29** (1) 186-196, 2013 (IF = 2.17).

Other Publications

11. N. Shirsat, N. English, B. Glennon* & M. al-Rubeai, 'Modelling of Mammalian Cell Cultures', *Animal Cell Culture, Cell Engineering 9*, Springer, ed. M. al-Rubeai, 2015.
12. N. Shirsat, M. Avesh, N. English, B. Glennon* & M. al-Rubeai, 'Verhulst and stochastic models for comparing mechanisms of MAb productivity in six CHO cell lines'. *Cytotechnology*, **68** (4) 1499-1511, 2016. DOI: 10.1007/s10616-015-9910-9. (IF = 1.86).
13. Y. Gao, J.K. Wang, Y.L. Wang, Q.X. Yin, B. Glennon, J. Zhong, J.B. Ouyang, X. Huang & H.X. Hao, 'Crystallization Methods for Preparation of Nanocrystals for Drug Delivery System', *Current Pharmaceutical Design*, **21** (22) 3131-3139, 2015. (IF = 3.05).
14. L. Simon *et al.*, 'Assessment of Recent Process Analytical Technology (PAT) Trends: A Multiauthor Review', *Organic Process Research & Development*, **19**, 3-62, January, 2015. (IF = 2.92).
15. N. Shirsat, M. Avesh, N. English, B. Glennon* & M. al-Rubeai, 'Revisiting Verhulst and Monod models: Analysis of batch and fed-batch cultures'. *Cytotechnology*, **67** (3) 515-530, 2015. DOI: 10.1007/s10616-014-9712-5. (IF = 1.86).
16. G. Hou, G. Power, M. Barrett, B. Glennon*, G. Morris & Y. Zhao, 'Development and characterization of a single stage MSMPR crystallization process with a novel transfer unit', *Crystal Growth and Design*, **14** (4), 1782-1793, 2014. (IF = 4.43).
17. N. Shirsat, M. Avesh, N. English, B. Glennon* & M. al-Rubeai, 'Application of statistical techniques for elucidating flow cytometric data of batch and fed-batch cultures', *Biotechnology and Applied Biochemistry*, **60** (5), 536-545, 2013. (IF = 1.43).
18. W. Su, H. Hao, B. Glennon* & M. Barrett, 'Spontaneous Polymorphic Nucleation of d-Mannitol in Aqueous Solution Monitored with Raman Spectroscopy and FBRM', *Crystal Growth and Design*, **13** (12), 5179-5187, 2013. (IF = 4.43).
19. J. Whelan, S. Craven & B. Glennon*, 'In Situ Raman Spectroscopy for Simultaneous Monitoring of Multiple Process Parameters in Mammalian Cell Culture Bioreactors', *Biotechnology Progress*, **28** (5), 1355-1362, 2012. (IF = 2.17).
20. S. Ferguson, G. Morris, H. Hao, M. Barrett & B. Glennon*, 'In-situ Characterization of Plug-Flow Crystallizers', *Chemical Engineering Science*, **77**, 105-111, 2012. (IF = 2.75).
21. D. Duffy, N. Cremin, M. Napier, S. Robinson, M. Barrett, H. Hao & B. Glennon*, 'In Situ Monitoring, Control and Optimization of a Liquid-Liquid Phase Separation Crystallization',

Chemical Engineering Science, **77**, 112-121, 2012. (IF = 2.75).

22. J. Whelan, E. Murphy, A. Pearson, P. Jeffers, P. Kieran, S. McDonnell & B. Glennon*, 'Use of Focussed Beam Reflectance Measurement for Monitoring Changes in Biomass Concentration', *Bioprocess and Biosystems Engineering*, **35** (5), 963-975, 2012. (IF = 1.90).
23. H. Hao, M. Barrett, Y. Hu, W. Su, S. Ferguson, B. Wood & B. Glennon*, 'The Use of in situ Tools to Monitor the Enantiotropic Transformation of P-aminobenzoic Acid Polymorphs', *Organic Process Research and Development*, **16** (1), 35-41, 2012. (IF = 2.92).
24. M. Barrett, H. Hao, A. Maher, K.B. Hodnett, B. Glennon* & D. Croker, 'In-situ monitoring of supersaturation & polymorphic form of Piracetam during batch cooling brystallization', *Organic Process Research and Development*, **15** (3), 681-687, 2011. (IF = 2.92).
25. M. Barrett, D. O'Grady, E. Casey & B. Glennon*, 'The role of meso-mixing in antisolvent crystallization processes', *Chemical Engineering Science*, **66**, 2523-2534, 2011. (IF = 2.75).
26. W. Su, H. Hao, M. Barrett & B. Glennon*, 'The Impact of Operating Parameters on the Polymorphic Transformation of d-Mannitol Charaterized in situ with Raman Spectroscopy, FBRM and PVM, *Org. Process Res. Dev.*, **14** (6), 1432-1437, 2010. (IF = 2.92).