



國立台北科技大學高值生醫材料研究與商品化中心專題演講 (二)

題目：Structured soft polymers as functional biomaterials

講者：Liam M Grover / Healthcare Technologies Institute, School of Chemical Engineering, University of Birmingham, UK

時間：2023 年 08 月 30 日(星期三) PM 15:20~17:00

地點：化工館 101 電化教室

## **Structured soft polymers as functional biomaterials**

Prof. Liam M Grover, PhD, FIMMM, FMedSci

Healthcare Technologies Institute, School of Chemical  
Engineering, University of Birmingham, UK

Hydrogels have been used as biomaterials for the delivery of therapeutics for decades now. They find use as wound dressings, contact lenses and more recently have been employed for the delivery and retention of biologically active entities such as cells into the body. The complexity of the polymers from which the majority of hydrogels are formed, in addition to the potential for structuring on multiple length scales means that there is still significant potential to innovate, tuning mechanical properties, biodegradation and even controlling biological environments. This talk will discuss how we have taken polymers with known toxicity profiles and modified them through physical and chemical processes in order to produce materials that can deliver drugs over a sustained period of time (>6h on the surface of the eye) or even act as sinks for growth factors or as surface lubricants. I will discuss how we have used shear-structuring to develop gellan-based materials for the alleviation of severe dry eye and the prevention of scarring following microbial keratitis. In addition, I will report how we have created composite materials that not cover a larger surface area than existing sprays, but also exhibit muco-adhesive properties. These sprays have been used to prevent viral infection and also to mediate inflammation and reduce scarring in the mouth of patients with epidermolysis bullosa. Notably, all of the technologies in this presentation have been manufactured in a way that has enabled them to reach first-in-human trials, with two of the technologies being currently available commercially.

**Professor Liam M Grover, BMedSc(Hons), PhD, FMedSci, FIMMM, FHEA, FCASMI**

**E-mail:** [L.m.grover@bham.ac.uk](mailto:L.m.grover@bham.ac.uk)

**Tel:** +44-121-414 3887 **Twitter:** @DWLiam **DOB:** 03.03.80

**URL:** <https://www.birmingham.ac.uk/staff/profiles/chemical-engineering/grover-liam.aspx>

---

#### **EMPLOYMENT HISTORY:**

**2018-Present** – Director of the Healthcare Technologies Institute, University of Birmingham

**2013- Present** – Professor of Biomaterials Science, School of Chemical Engineering, University of Birmingham (also holding position of Deputy Head of School)

**2012-2019** – Director of Research, School of Chemical Engineering, University of Birmingham

**2012-2013** – Reader in Biomaterials Science, School of Chemical Engineering, University of Birmingham

**2010-2012** – Senior Lecturer in Chemical Engineering, University of Birmingham

**2006-2010** – Lecturer in Chemical Engineering, University of Birmingham

**2004-2006** – CIHR Skeletal Health Scholar, McGill University, Montreal

---

#### **EDUCATION HISTORY:**

**2001 – 2005** – PhD in Dentistry, University of Birmingham. Thesis Title: “Cold-setting properties of calcium phosphate – pyrophosphoric acid – water mixes.”

**1998 – 2001** – BMedSc(Hons), Biomedical Materials Science, University of Birmingham

---

#### **RESEARCH PROJECT GRANTS (running in the last 3 years):**

1. West Midlands Healthcare Technology Innovation accelerator - £16m, Innovate (PI), 2023-2025
2. A novel eye drop to lubricate the ocular surface of patients with EB. DEBRA (PI), £180k, 2023-2025
3. NIHR BRC Theme leader, Birmingham – Next Generation Therapies - £1.3m, 2022-2027
4. SMARTSHAPE – Designing a novel shape memory polymer for minimally invasive delivery of a sensor system, EU Horizon 2020 (PI), £1.4m, 2023-2026
5. An antimicrobial dressing material – NIHR i4i (PI), £1.3m, 2022-2025
6. A novel spray delivery system for the treatment of mucosal scarring in epidermolysis bullosa. DEBRA (PI), £180k, September 2020-August 2022.
7. MedTect Connect, Innovate UK (PI), Seed funds to strengthen full application, £50k
8. DEMAND hub – a centre for the acceleration of medical technologies, ERDF £3.5m (PI), July 2020- June 2023.
9. PREMIER – Platform Grant, EPSRC (CI), £6.3m (£1.3m to Bham), 2019-2024.
10. lifETIME – Centre for Doctoral Training (UoB PI), EPSRC £7m 2019-2027
11. Biodegradable hybrid screws for ligament-bone interface regeneration, EPSRC (UoB PI), £1.1m
12. An organotypic model of the bone remodelling process, NC3RS (CI), £100k, Oct 2019- Sept 2022.
13. Decorin delivering gels for burn dressings (PI). Scar Free Foundation, approx. £1m, Oct 2018 – Sept 2023.
14. Fluid-Gels as Resorbable Protective Dressings for Ocular Surface Disease (CI), NIHR i4i, £1.6m, Feb 2019 – Jan 2024.
15. PREVENT (PI), EPSRC, £1.3m, Sept 2017-August 2020
16. MD-Tech (PI), ERDF, £7m total, Jan 2018 – December 2020
17. A novel treatment for heterotopic ossification. PI, ORUK, £100k, Feb 2016-2018
18. UNIFY+, A network focussed on the treatment of fracture non-union (Bham PI), EPSRC, £500k, 2016-2018

19. A flowable dressing to inhibit scarring on the cornea (CoPI). MRC DPFS - £2.8m 2016-2023
20. A novel biomembrane with antiscarring properties (CoPI). Wellcome Trust Healthcare Innovation Challenge, - £1.8m 2015-2018.

#### **SUPERVISION OF GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS:**

Prof. Grover has supervised 38 PhD students and one MPhil student to completion. Of the students that have graduated, the majority remain in science and one has set up their own business. He is excellent at mentoring staff and students and six of the people who have passed through his research group now have permanent academic positions (One Full Professor – Prof. AM Smith). The others have secured postdoctoral positions in institutions including: Yale University, UCL, Newcastle University, Central South University, Ocean University and the National Institutes of Health – Taiwan or in industry (BP and CERAM). Partly due to his mentorship, staff affiliated to his research institute have managed to secure ERC fellowships (X2), EPSRC fellowships (X4), a Royal Academy of Engineering fellowship, two FLF fellowships, a Wellcome Career Development fellowship, and an NC3Rs fellowship.

---

#### **FELLOWSHIPS AND AWARDS:**

- |                       |   |
|-----------------------|---|
| <b>2023</b>           | President's award - UKSB  |
| <b>2023</b>           | Fellow of the Academy of Medical Sciences   |
| <b>2022</b>           | Nominated for the OBN Best Start-up award – Healome Therapeutics  |
| <b>2022</b>           | Materials Innovation Award – Antiviral Nasal Spray  |
| <b>2018-Present</b>   | Fellow of the Centre for the Advancement of Sustainable Medical Innovation  |
| <b>2018</b>           | Special commendation from the IChemE on the development of a process to manufacture antifibrotic eye drops            |
| <b>2016</b>           | Awarded Civilian Membership of the for the Combined Services Orthopaedic Society for work on heterotopic ossification |
| <b>2011 – Present</b> | Fellow of the Higher Education Academy, UK  |
| <b>2010 – Present</b> | Fellow of the Institute of Materials, UK  |
| <b>2004 – 2006</b>    | CIHR Skeletal Health Scholarship, Faculty of Dentistry, McGill University, Montreal, Canada                           |

#### **ORGANISATION OF SCIENTIFIC MEETINGS:**

- |             |   |
|-------------|---|
| <b>2016</b> | Royal Society of Chemistry Annual Biomaterials Meeting                              |
| <b>2014</b> | Cell Adhesion Century and Satellite Meeting on NanoBio Interactions (Royal Society) |
| <b>2013</b> | Young Researchers Meeting, Biochemical Engineering Subject Group, IChemE            |
| <b>2010</b> | Cement and Concrete Science, International Conference, IOM3                         |
- 

#### **CITIZENSHIP**

#### **COMMISSIONS OF TRUST:**

- |                       |   |
|-----------------------|---|
| <b>2022</b>           | Canada Foundation for Innovation, Innovation Fund   |
| <b>2019 – Present</b> | Editorial Board – Advanced NanoBiomed Research  |
| <b>2018 – Present</b> | External advisor to the Versus Arthritis Tissue Engineering Centre                              |
| <b>2018 – Present</b> | ESRC Mental Health Panel  |
| <b>2018 – Present</b> | NIHR i4i Panel Member   |
| <b>2017 – Present</b> | Member of Editorial Board for APL Bioengineering  |
| <b>2017 – Present</b> | Member of Editorial Board for Journal of Applied Biomaterials and Journal of tissue Engineering |
| <b>2016 – Present</b> | Panel member for NC3Rs strategic awards   |

**2014 – Present** Panel member for the British Council – Israel (BIRAX) funding scheme  
**2014 – Present** Panel member of NIHR, i4i Regenerative Medicine  
**2014 – Present** Member of Editorial Board, Scientific Reports  
**2013 – Present** Mercia Outreach for the EPSRC Centre for Innovative Manufacturing in Regenerative Medicine  
**2013 – 2016** Visiting Professor, University of Sao Paolo  
**2010 – Present** Member of Editorial Board, Advances in Applied Ceramics

Reviewer for numerous journals including Science Translational Medicine, Biomaterials, Advanced Materials, and Advanced Functional Materials. Reviewer for national and international funding bodies, including the EU (ERC), the BBSRC, EPSRC, MRC, ORUK, TSB, Hong Kong Research Council, DFG (Germany), Leuven University, Polish Research Council, Cypriot Research Council, CIHR.

#### **DUTIES AS AN EXTERNAL EXAMINER:**

*PhD/DPhil examinations:* Swansea University (X2), University of Twente, University of Utrecht, SSSA Pisa, Oxford University (X5), UCL (X8), KCL, Imperial College, Nottingham University (X4), Keele University, Loughborough University, Warwick University, University of Manchester, QMW (x3), University of Leeds (x1), University of Bath, Herriot Watt University, University of Waikato

*Examination of undergraduate programmes:* External examiner for the MSci in Medical Sciences and Engineering at UCL, External Examiner for undergraduate chemical engineering course at the University of Lancaster

#### **EXTERNAL COMMITTEES:**

**2019 – Present** Member of the EPSRC Healthcare Technologies Strategic Advisory team  
**2015 – Present** Institute of Physics and Engineering in Medicine, Bioengineering sub-group  
**2015 – Present** Royal Society of Chemistry, Biomaterials Chemistry Subject group –  
**2011 – 2014** IChemE Biochemical Engineering Subject Group –  
**2008 – 2012** IOM<sup>3</sup> Cement and Concrete Science Subject Group –

---

#### **RESEARCH OUTPUT:**

Since being awarded his PhD in 2005, he has published in excess of 200 peer reviewed papers in Journals including Advanced Materials (X5), Advanced Functional Materials and Biomaterials (X16) and currently has a H-index of 50 with >9000 citations (see publication list). His work has been featured in Nature Materials, on the BBC and in Materials World.

#### **INVITED LECTURES:**

Professor Grover has given invited lectures in the UK and internationally on more than 60 occasions and has spoken at institutions in the US, Brazil, Canada, Norway, China, Italy, Germany, the Netherlands, Japan, and France. He has given invited keynote/plenary talks at all of the major conferences in his field: ESB, TERMIS, WBC, FIRM, SCARCON.

---

#### **MEDICAL INNOVATION:**

An extremely strong record in the area of medical innovation with more than ten patent filings

that describe the development of novel biomaterials. He has made innovative contributions in a diversity of medical technologies, including:

**Osteogenic bone cements:** He invented a new ceramic bone replacement, for which two patents were filed (WO2004028576, US 61/016212). The material was developed with Smith and Nephew and was taken to the point of clinical trial. **A new formulation of this material is currently being developed for commercialisation in China.**

**Structured pyrophosphate particles:** During his research fellowship at McGill University (with Profs. Jake Barralet and Marc McKee), he invented a method for the production of fibrous calcium pyrophosphate particles, which was subsequently patented (PCT/CA2007/001221). He took this material to trial as a topical delivery agent in healthy volunteers (at the University of Birmingham), setting in place the ethical approvals that were required for such a study. **A company was spun out from McGill University (NanuNanu Ltd).**

**Anti-scarring dressings:** He has developed a patent portfolio around the delivery of antifibrotic agents using soft materials. He was awarded funding by the Wellcome Trust, the ScarFree Foundation, and the NIHR to take these technologies to the clinic and **he has developed a small manufacturing facility in his research institute for the delivery of these dressings into UHB and is in the process of identifying a partner for commercialisation.**

**Eye-drops:** A new eye-drop technology that allows for the retention of therapeutics across the surface of the eye for upwards of 4 hours (GB1820021.2, GB1820018.8, GB1521784.7, US2016/045553 EP2968405A). More than £5m has been secured to use these technologies for the retention of serum on the ocular surface (NIHR i4i) for the treatment of dry eye, delivering the technology into the NHS through NHSBT, and the delivery of decorin onto the surface of the eye of individuals with microbial keratitis (MRC DPFS). His eye-drop technologies have necessitated the development of a novel sterilisation process (GB1820022.0), which he is working with the MHRA to validate. **This technology is currently being exploited by the spin-out – Healome Therapeutics Ltd, which has received start-up funding and was nominated for the OBN best start-up award in 2022.**

**COVID response:** His research team were back in labs from April 2020 working on bespoke, reusable PPE (**patent licensed to MyMask Fit**) with a team from KCL. His team has also developed a nasal spray that prevents SARS Cov2 infection in live cultures (**patent licensed to Birmingham Biotech**). **The nasal spray is now available across South East Asia, having gone from concept to use in nine months.**

### **Leadership in medical innovation**

He is a recognised leader in medical innovation and is working with academics and companies across the country to move technologies rapidly into clinical use. His vision has resulted in the establishment of the Healthcare Technologies Institute (HTI) at the University of Birmingham, the activities of which will expand onto the Birmingham Health Innovation Campus (BHIC) through the Precision Health Technologies Accelerator (PHTA). He has worked with the West Midlands Combined Authority (WMCA) to secure government funding to drive growth in the Medical Technology sector across the Midlands. At present his team is working to provide education in medical innovation into both engineering and medical curricula.

---

### **WIDENING PARTICIPATION:**

He is very keen to enhance participation and to engage school children with the excitement of applied science and engineering. He is also an advocate of the development of a 'rounded' multidisciplinary scientific background. His commitment to outreach is best demonstrated through:

- Participation in Pint of Science events in 2018 (2X, organised by UoB and Fight for Sight) and 2019 (NC3Rs).
- Involvement in communication with Patient Groups at the University of Birmingham, through the SRMRC and the Conflict Wound Centre
- Talks delivered on behalf of charitable funders (ScarFree Foundation and Fight for Sight) to potential donors.
- Dissemination of major research findings through interviews on the radio (BBC R4 and WM), and on the television (BBC, ITV).
- Life-science in 6 event held at the Birmingham REP, 20 slide – six minute presentation on the use of sugar to treat burns  
(<https://www.youtube.com/watch?v=YAspAWMA6Cs>)
- The delivery of talks to the Association of Secondary Science Educators which emphasised the importance of multidisciplinary science.
- He has given a talk at the British Science Festival on Regenerating the Human Body, which gained a lot of national press interest  
(<http://www.telegraph.co.uk/news/science/science-news/11093248/Could-the-salamander-spell-the-end-of-hip-replacement-operations.html>).

