

# Intelligent Anti-Infective Biomaterials



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# Contents

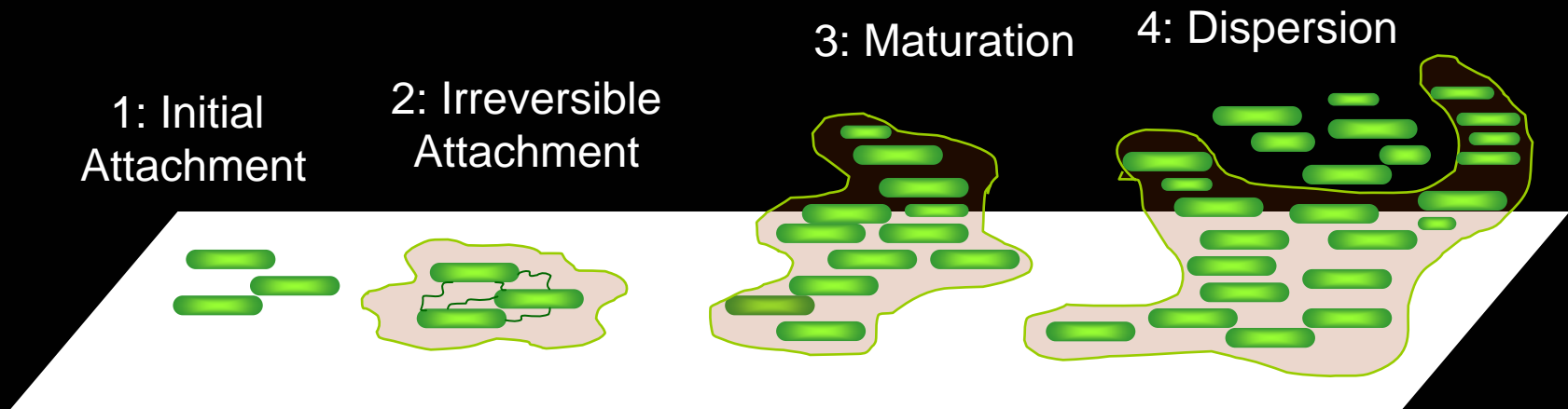
- Background
- Concept
- Production of Materials
- Mechanical Properties
- Drug Release
- Conclusion

# Medical Device Technology

- Medical devices are now routinely used
- Market value of > \$100 billion
- 40% of nosocomial infections are associated with urinary medical devices
- NHS costs: £1 billion/year

# Background

- Medical Device Infection
  - Infection of urinary tract with urease-producing bacteria e.g. *Proteus mirabilis*
  - Urinary tract infection (UTI) extremely common with long-term catheterization
  - Biofilm – resistant to antibiotic treatment



# Encrustation

Urease producing bacteria

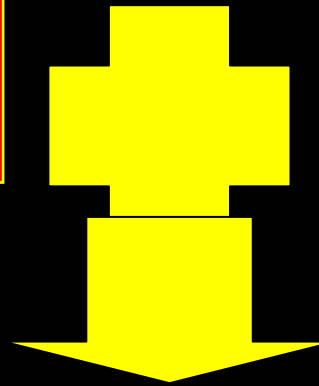
pH ↑



# Concept

**Antibiotics**

**Resistant Coating**



**Dual Action:  
Antibiotic + Resistant**

# Aims

- Elute antimicrobiological agents in a controlled manner

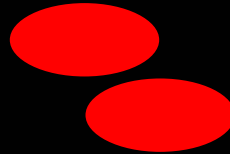
WITH

- Failsafe mechanism that recognises the onset of infection and initiates an intelligent response

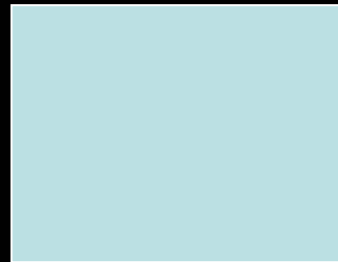
# Concept

- Intelligent system reacts in vivo to changes in urinary pH

Bacteria

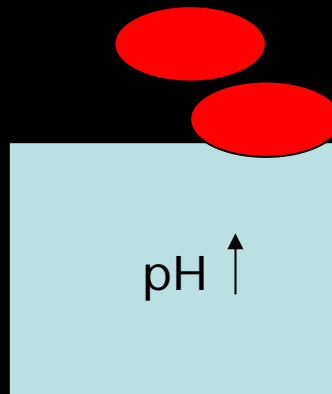


Drug loaded  
catheter coating



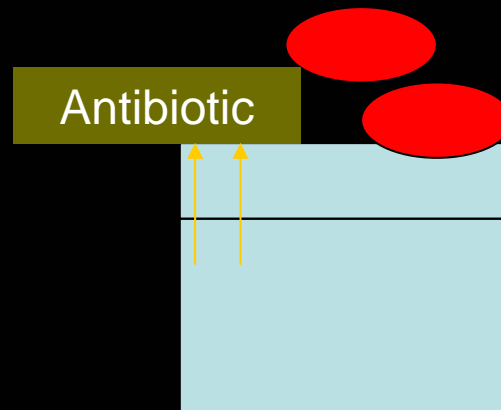
# Concept

- Intelligent system reacts in vivo to changes in urinary pH

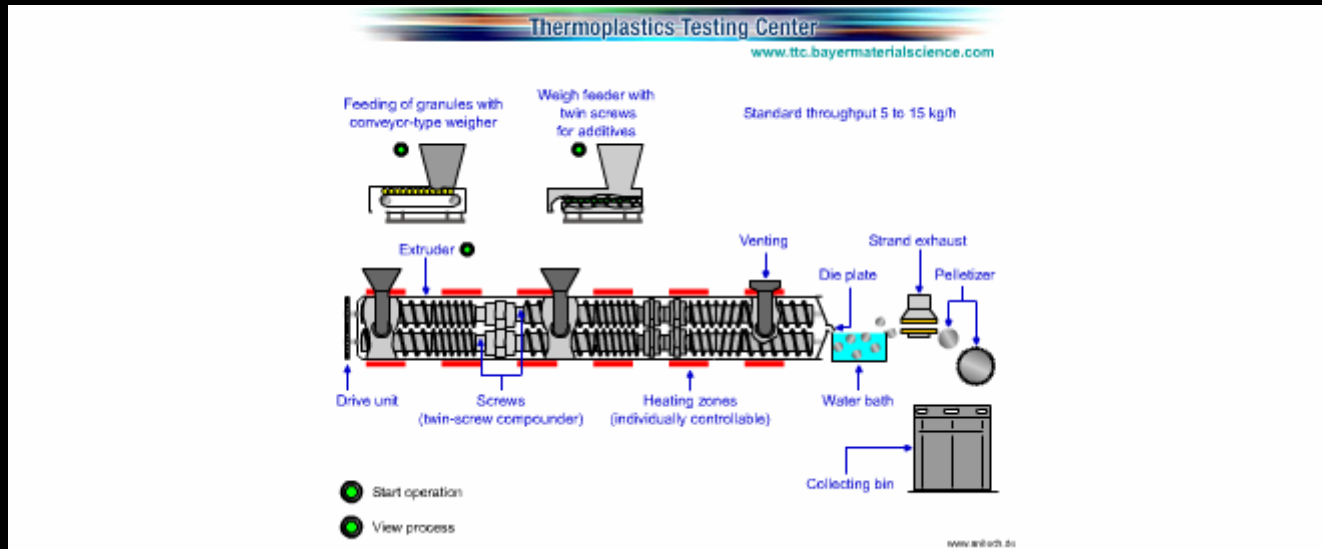


# Concept

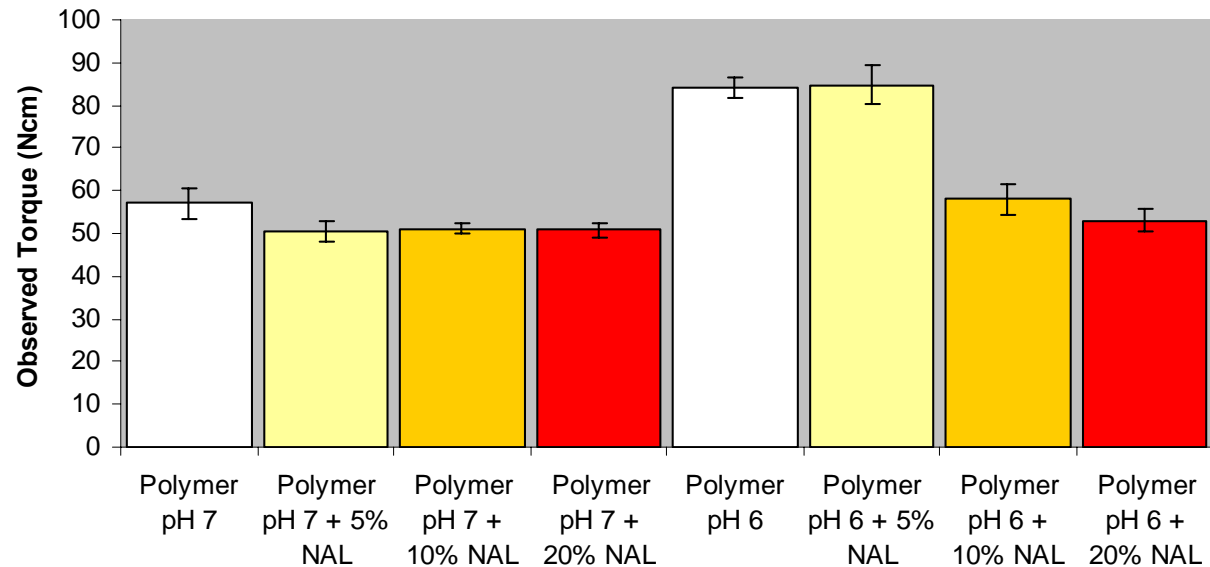
- Intelligent system reacts in vivo to changes in urinary pH



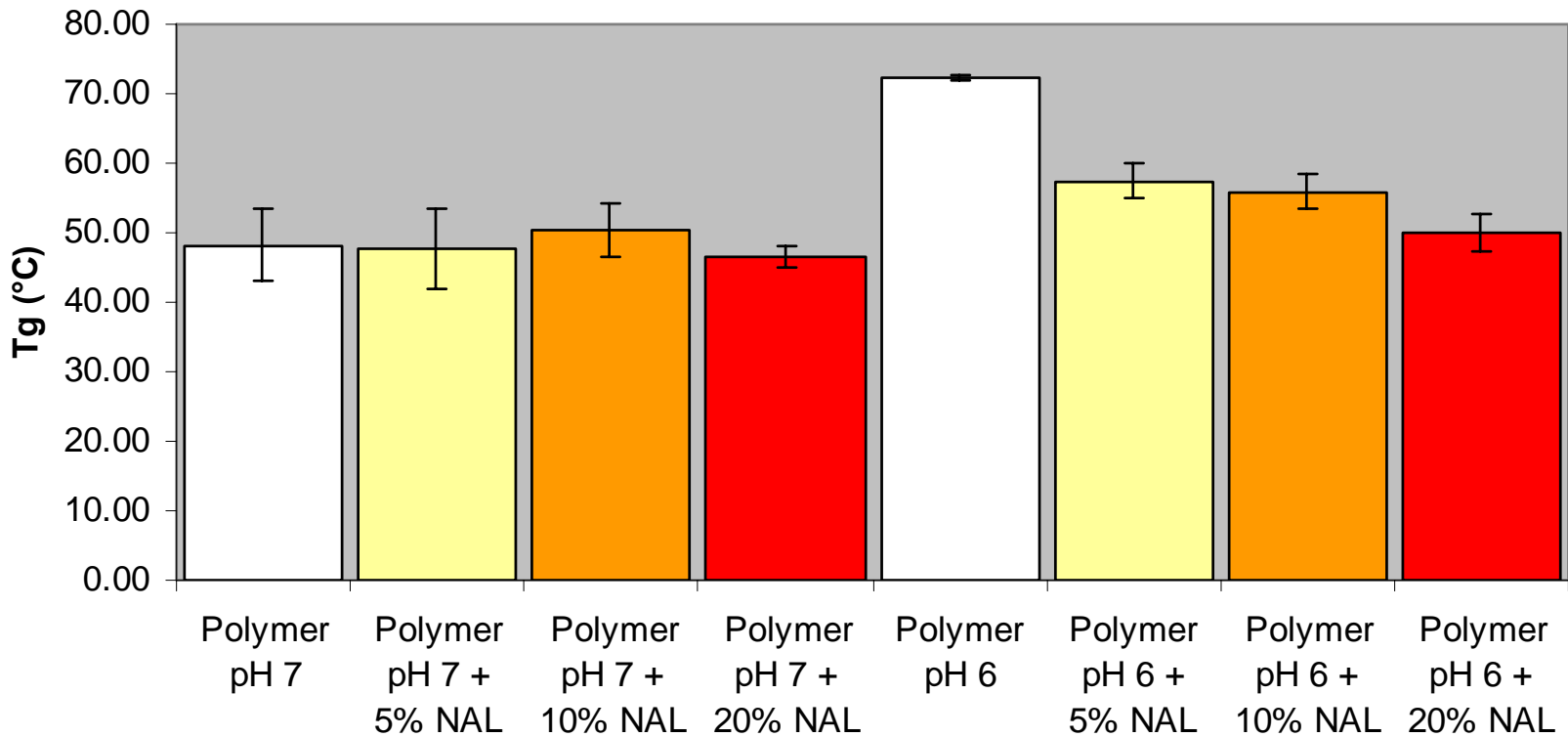
# Production: Hot melt extrusion



[http://www.ttc.bayermaterialscience.com/bpo/bpo\\_ttc.nsf/id/Twin-screw\\_extrusion](http://www.ttc.bayermaterialscience.com/bpo/bpo_ttc.nsf/id/Twin-screw_extrusion)



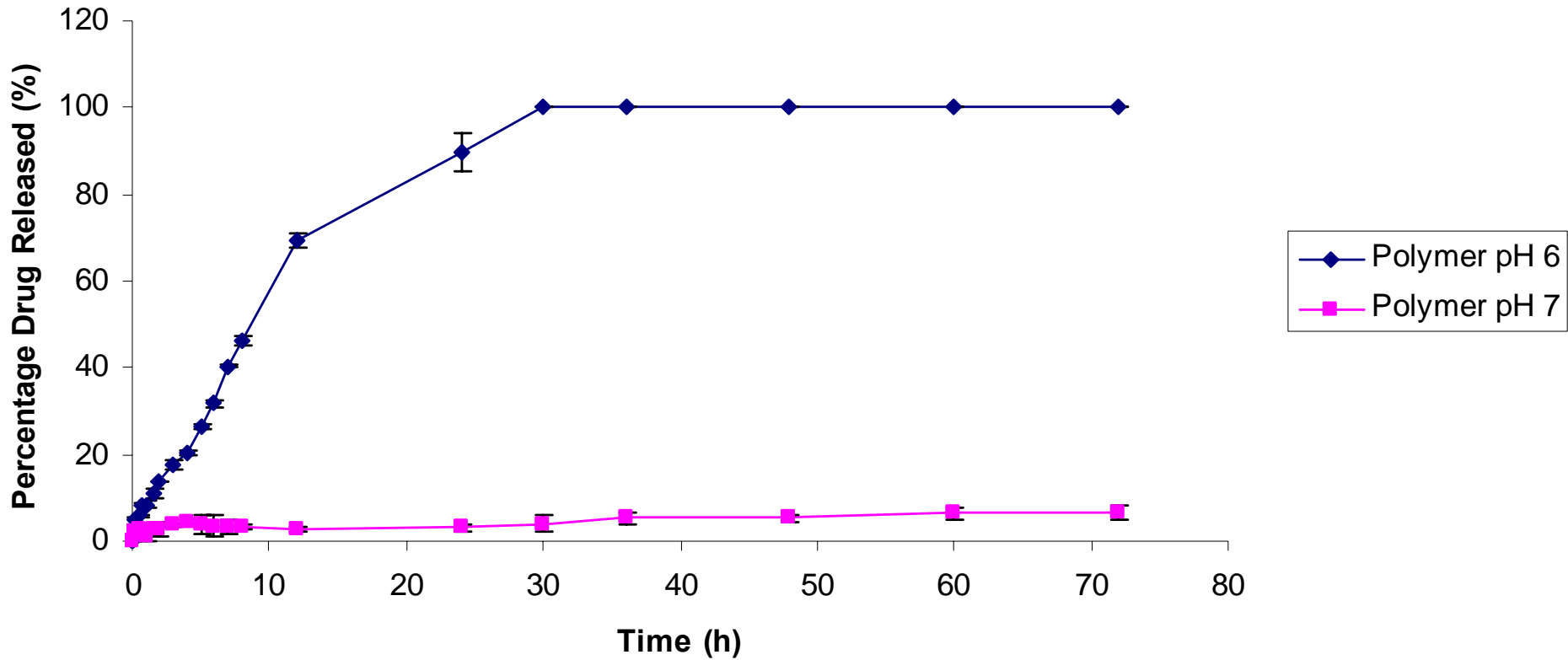
# Mechanical Properties: *Glass Transition*



# Drug Release

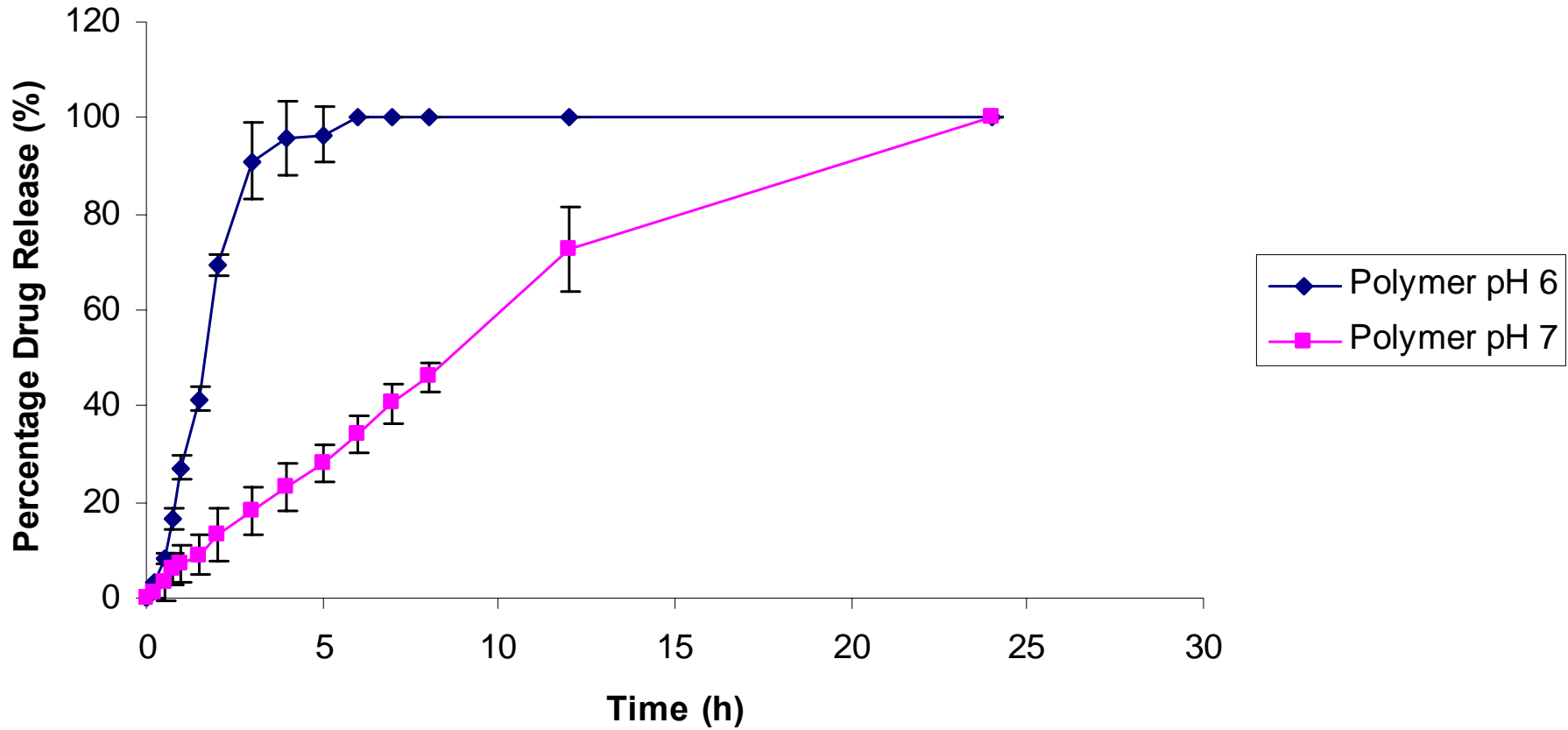
- Two pH values:
  - pH 6.2: healthy, uninfected urine
  - pH 7.8: infected urine<sup>1</sup>

# Release *pH 6.2, 10% Nalidixic Acid*



Time (h)	2h	4h	8h	24h
Polymer pH 6	13.8±0.2	20.4±0.6	46.3±1.1	89.7±4.5
Polymer pH 7	2.8±1.7	3.0±0.8	3.3±0.7	4.4±1.1

# Release pH 7.8, 10% Nalidixic Acid



Time (h)	2h	4h	8h	24h
Polymer pH 6	69.5±2.1	95.9±7.8	100.0±0.0	100.0±0.0
Polymer pH 7	13.2±5.6	23.1±5.1	46.1±3.0	100.0±0.0

# Conclusion

- Development of anti-infective urinary medical devices of great importance for patient care and NHS cost
- An intelligent coating can be used to cause triggered release of antimicrobial agents in response to device infection

# Acknowledgements

- Thanks to my supervisor, Dr Gavin Andrews
- Colleagues at the School of Pharmacy, QUB
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