TACKLING THE ANTIMICROBIAL RESISTANCE CRISIS:
DUAL DETECTION OF ANTIBIOTICS IN ENVIRONMENTAL AND FOOD SAMPLES WITH MOLECULAR IMPRINTING TECHNOLOGY

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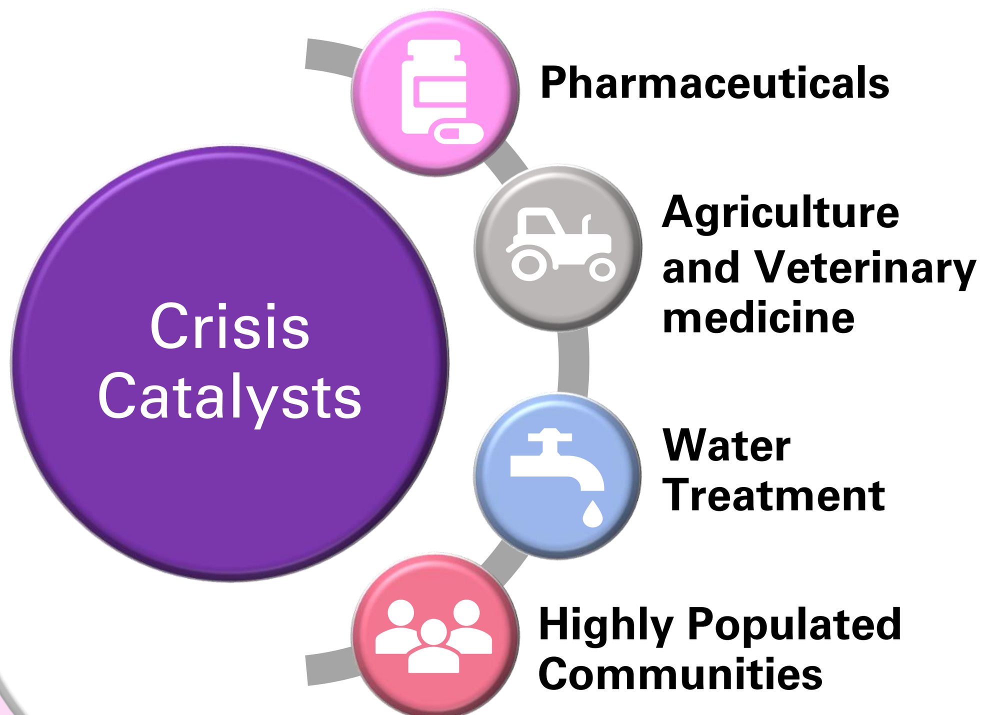
By 2050, AMR will cause **10 million fatalities** and cost **$100 trillion** annually[1]

1 The AMR Crisis

One major contributor is **Selective pressure** which describes the process by which microbials **adapt** and **mutate** when in the presence of low concentrations of antibiotics.
These environmental traces of antibiotics are the result of **poor control and use** from sources such as-



No new antibiotic agents discovered since 1987[2]

2 Molecularly Imprinted Polymers (MIPs)

These **custom-made synthetic recognition elements** act as artificial antibodies. Unlike biological antibodies, they have many commercially desirable traits as shown in the table

Function	MIP	Antibody
Sensitivity and selectivity	✔	✔
Versatility	✔	✘
Inertness	✔	✘
Customisable	✔	✘
Ethicality	✔	✘
Mass producible	✔	✘

Want to find out more?

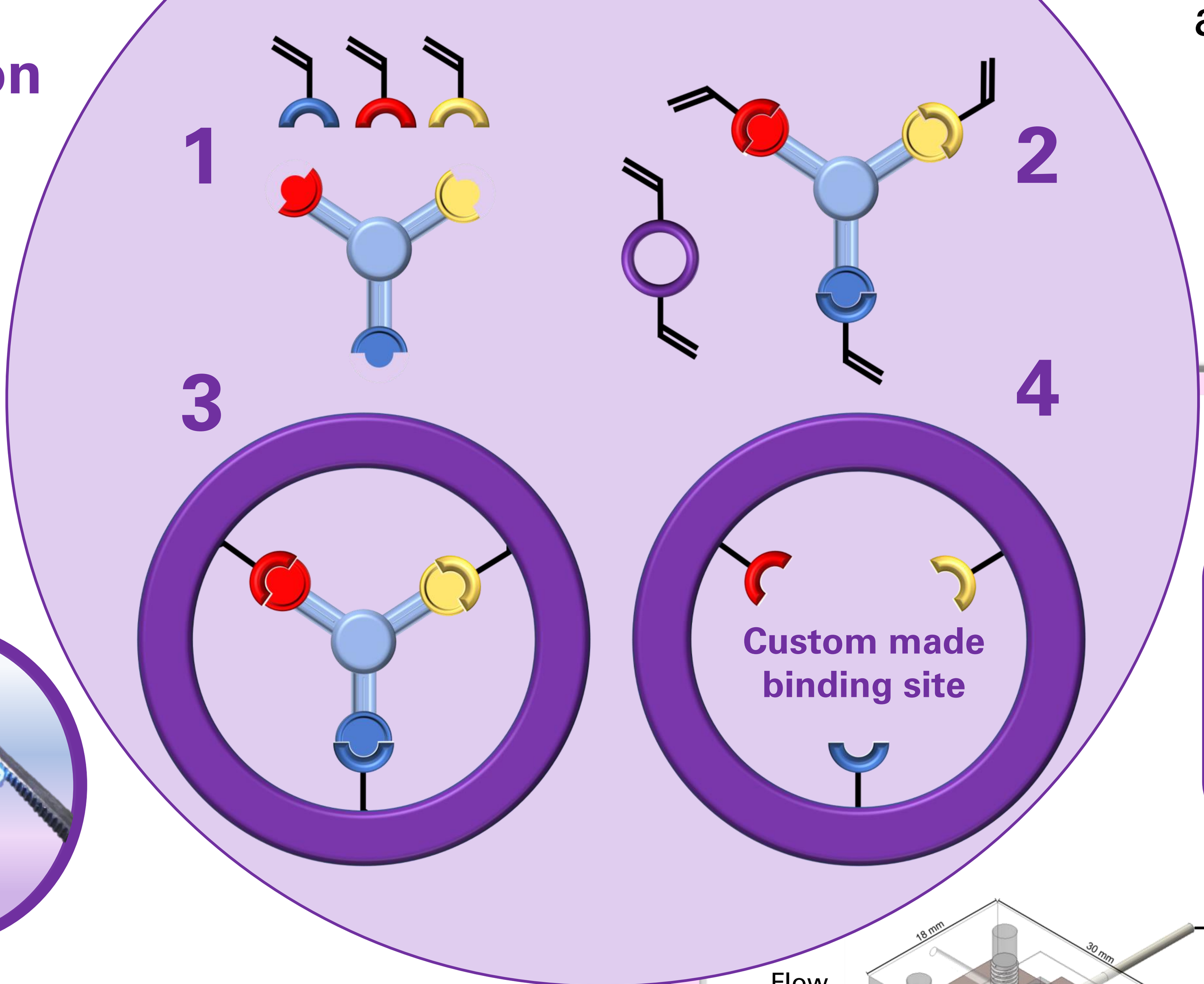
Check out our introduction to MIPs here!

Where can MIPs be employed?

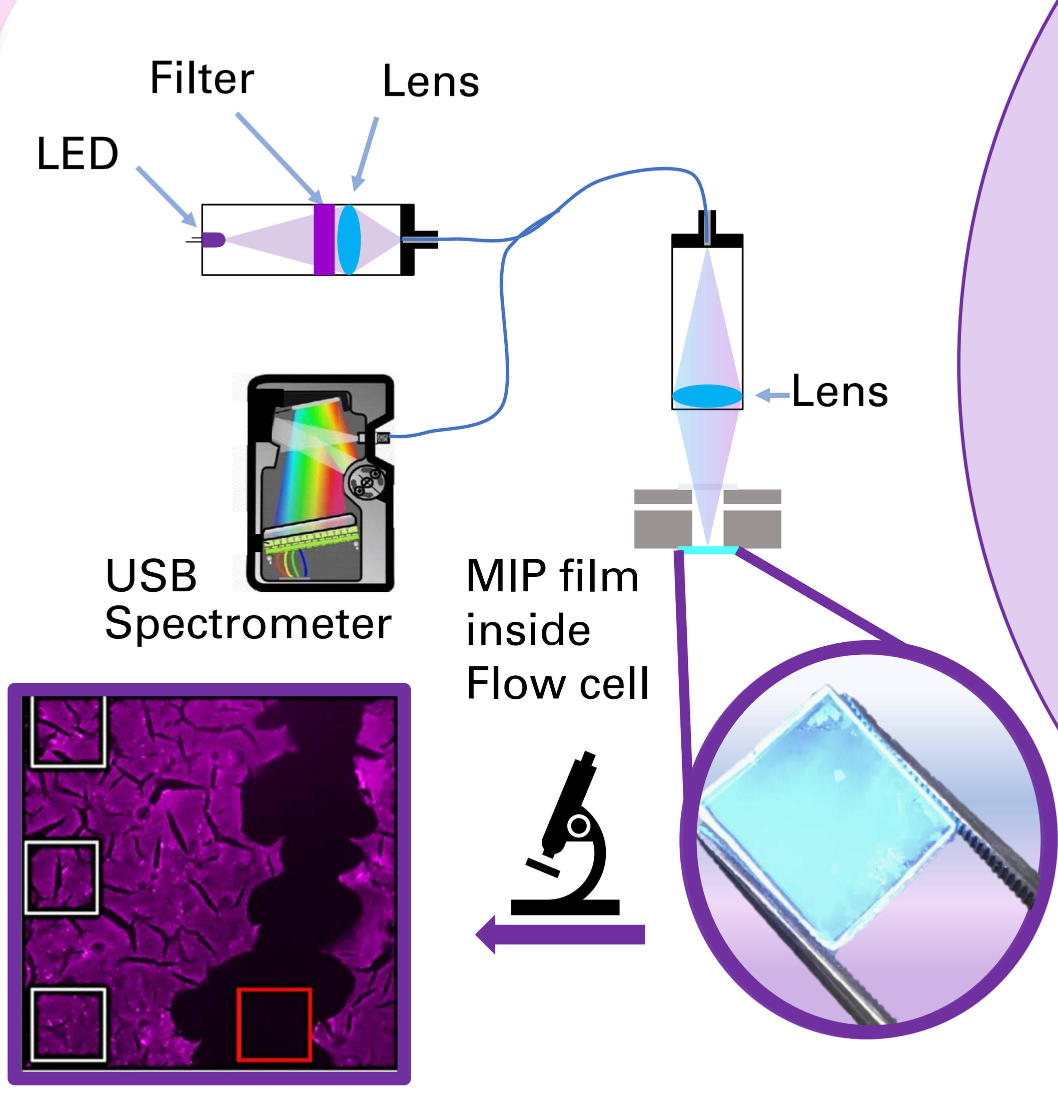
Due to the imprinting technique, unlike antibodies, MIPs can be custom made for a plethora of different targets including-

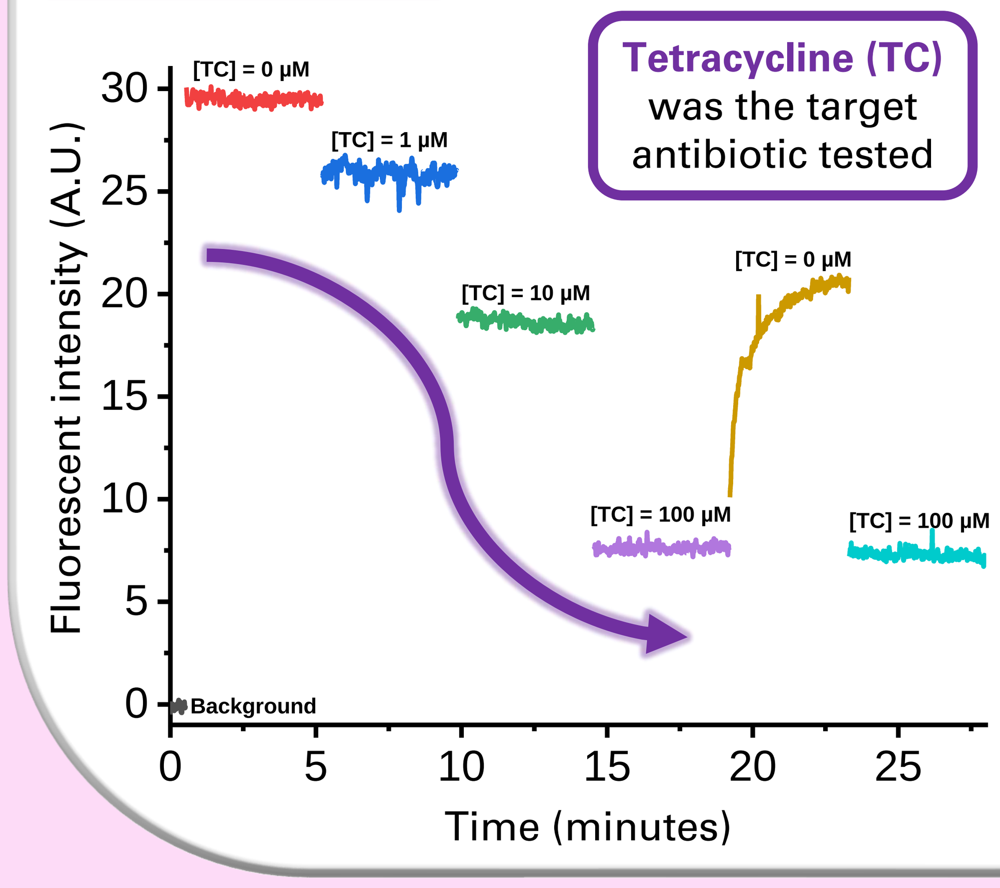
- Molecules
- Viruses
- Bacteria
- Proteins

MIP Synthesis



3 Fluorescent detection





Tetracycline (TC) was the target antibiotic tested

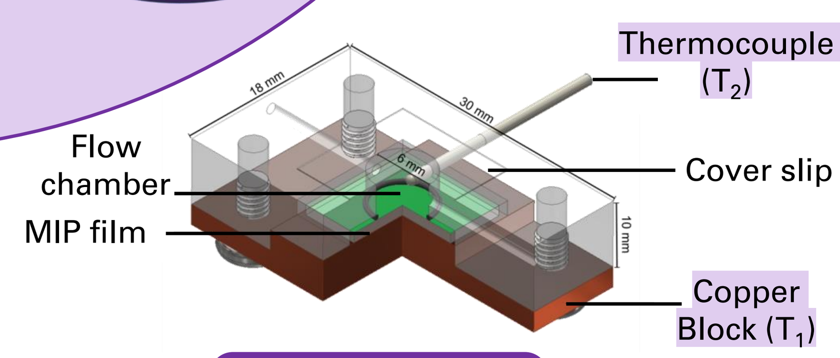
The **Inner Filter Effect (IFE)** explained that the fluorescent spectrums of both antibiotic and fluorescent polymer overlapped, resulting in **less excitation energy** available with sequent additions of the TC antibiotic thus fluorescent **quenching is observed**

4 Thermal detection

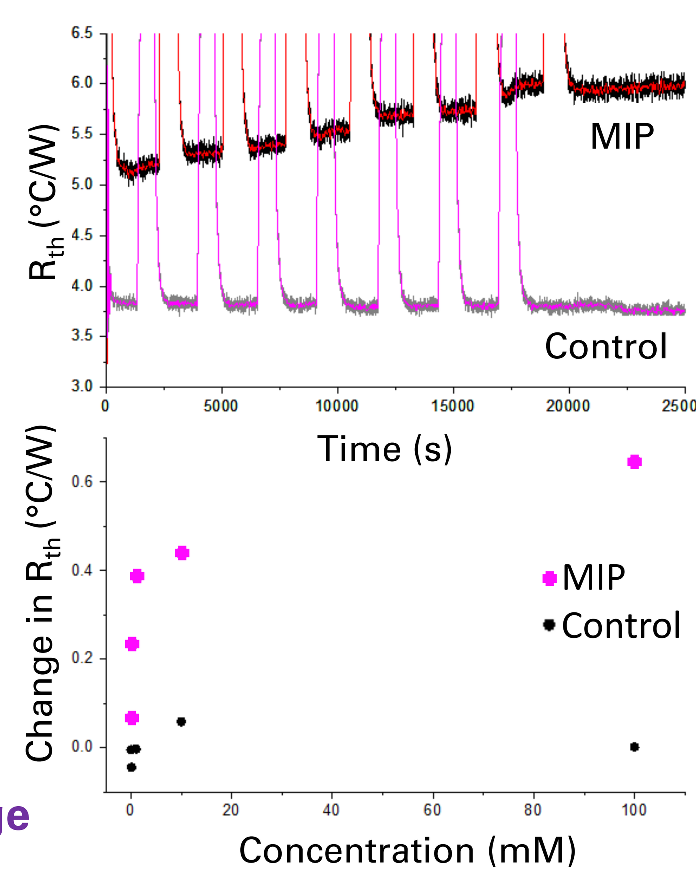
Principles of Thermal detection

↑ Target bound ↑ Thermal resistance

Thermal Resistance (R_{th}) is based on Temperature difference between the solid-liquid interface of T_1 and T_2 (highlighted)



$$R_{th} = \frac{T_1 - T_2}{Power}$$



As **TC binds to the MIP film**, the R_{th} increases

The control shows **no change** with TC concentrations

Dual Detection Sensor- Combination of Fluorescent and Thermal detection

5 Conclusion

This next generation sensor grants :

- **identification and understanding of** selectively pressurised environments
- proactive **legislation implementation**
- finite stock of antibiotics, requires control of their use and environmental presence
- **safeguard antibiotic medical efficiency**

Fluorescent Detection

- **~30% fluorescent quenching** on TC exposure
- **Reversal and revival of quenching** on washing and reintroduction of TC

Thermal Detection

- **LoD of 0.1±0.3 mM**
- Detection of TC was **8x faster** than the gold standard

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References-

1- L. J. Roope, *et al.*, *Science*, 2019, **364**
2- L. L. Silver, *American Society for Microbiology*, 2011, **24**

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