POINT-OF-CARE PORTABLE INSTRUMENT FOR THE DETECTION OF GENETIC TARGETS

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INTRODUCTION

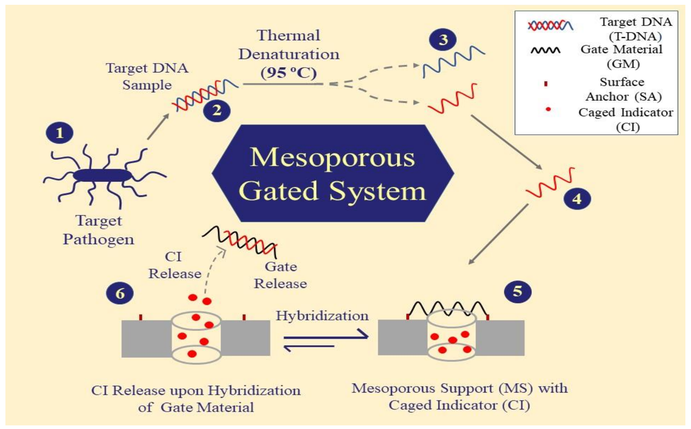
Infectious diseases & POC Device

- 3 of the top 10 cause of death in 2016 was infectious diseases with over 5.6 million people killed globally[1].
- For low-income African countries, 56% of total deaths were associated with infectious diseases or nutritional conditions[2].
- In developed countries, foodborne diseases, pathogen outbreak, and sexually transmitted disease (STD) are still a real threat[3].
- **Early detection of the pathogen is the key to prevent pathogen outbreak and recovery from the infection.**
- The current standard detection method is still based on the complex, expensive and time-consuming traditional culturing methods. An accurate, sensitive, and portable point of care (POC) diagnostic device could address early diagnosis and pathogen outbreak.
- **The aim of the research is to design, manufacture, and characterize the performance of a mesoporous gated system for a POC device based on genetic detection.**

Mesoporous Gated System (MGS)

A mesoporous gated system (MGS) consists of:

- A mesoporous support to enclose fluorophores (MS)
- A gate material released in the presence of pathogen
- A caged indicator from the target ensuring release of the gate (CI)

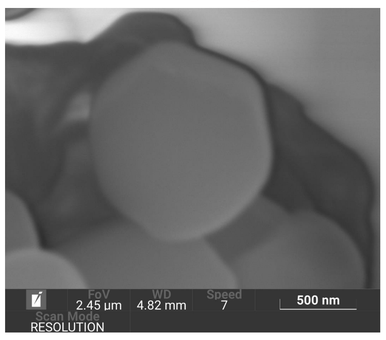


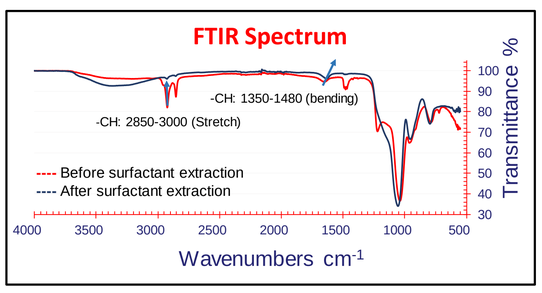
EXPERIMENTAL RESULTS & DISCUSSION

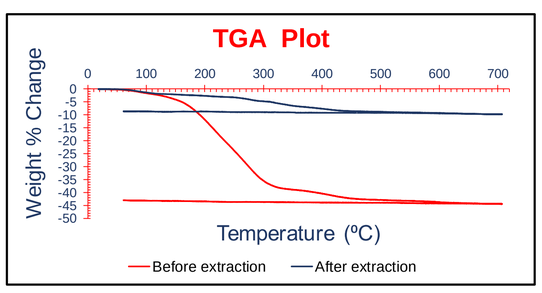
Fabrication of MGS

- Method: The mesoporous substrate (MCM 41) was synthesized by the Stöber sol-gel process[4].
- MCM 41 was successfully synthesized.
- Surfactant was extracted by acidic alcohol process.

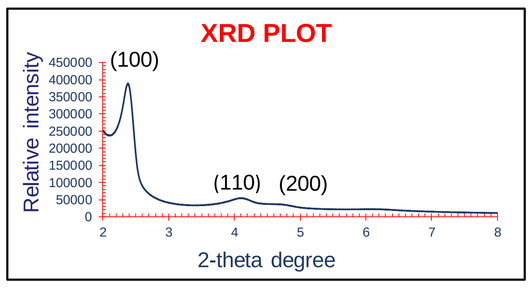
SEM Image

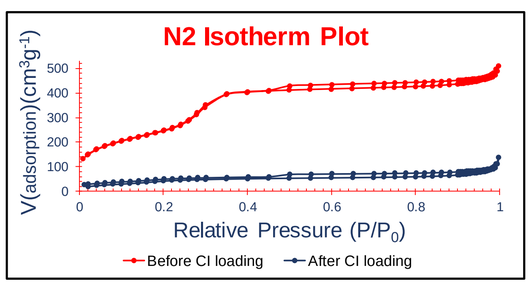




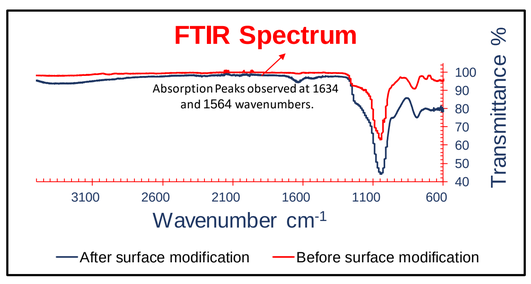


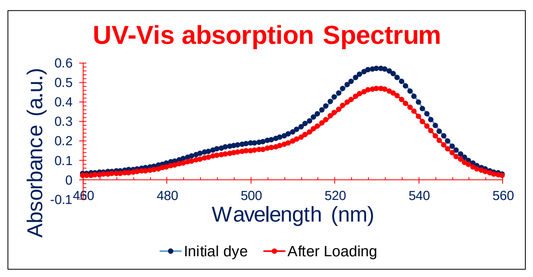
- The optimum extraction solvent was found to be 20 ml HCl in 200 ml of ethanol per gram of as-synthesized MCM 41 incubated for 15 hr at 60ºC.
- BET surface area, BJH pore volume and pore diameter were 309 $m^2.g^{-1}$, 0.610 $cm^3.g^{-1}$, and 1.89 nm.
- (100), (110), (200), and (210) Braggs peaks were observed in XRD spectrum.
- Increasing the quantity of reaction catalyst reduces aggregation of nanoparticles.





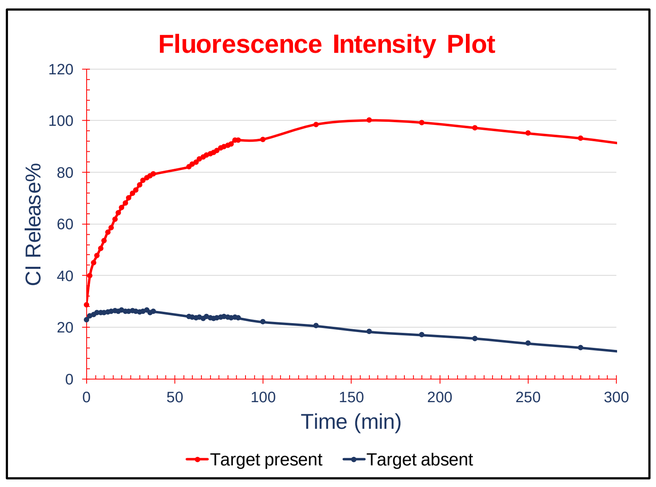
- The 2θ angle (100) peak was observed at 2.06 and the corresponding d spacing is calculated as 4.27 nm.
- MCM 41 surface was successfully modified with APTES.
- The average fluorescent dye loading was calculated as 0.735 mmoles per gram and of MCM 41 by UV-Vis adsorption method.





- The target for the gate release experiment is *Salmonella* spp.
- The gate experiment was performed in a microplate reader.
- 96 well plate black, fluorescent microplate was used for the experiment.
- The fluorescent measurement was performed with the mesoporous substrate suspended in the sample.

Gate Release Experiment



- The cage indicator (CI) release is negligible in the absence of target oligonucleotide.
- In contrast, the CI is released in the presence of target oligonucleotide.
- The CI release achieves 50% intensity in approximately 10 min.
- The intensity reduces gradually after 150 min, a period well beyond the reading of the diagnostic obtained by the POC device.
- The limit of detection is 100 femtomoles.

Summary & Future Work

The PhD thesis achieved the following:

- MCM 41 was successfully synthesized and characterized.
- Mesoporous Gated System was synthesized and characterized.
- In the gate released experiment, CI released is only observed in the presence of target material.
- More experiments need to be performed to fully characterize and optimize the gate release experiment.
- A cost-effective fluorophore detection system is currently under development.

References

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Scottish Funding Council
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