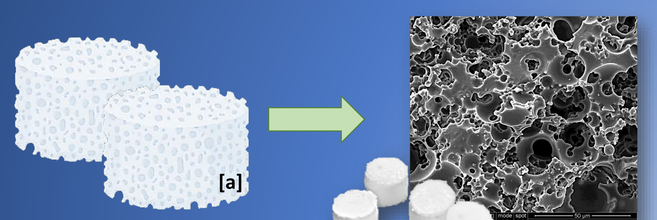
Bioceramic composite of PCL polyHIPE scaffold for biomedical applications

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Background

Pore size and **porosity** significantly influence **tissue engineering scaffolds**, particularly their ability to facilitate **bone regeneration**.

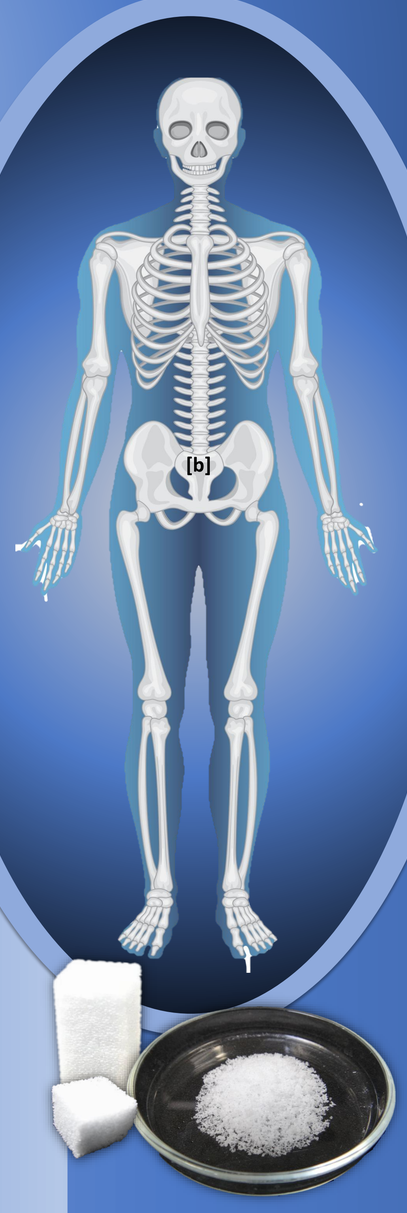


The **PolyHIPE scaffold** exhibits **microporosity** linked **interconnected pores** throughout its structure.

Hydroxyapatite (HA) is a **bioceramic** material that can improve its characteristics via the replacement of **zinc-substituted hydroxyapatite (HA-Zn).**



Polycaprolactone (PCL) has received certification from the **US Food and Drug Administration (FDA)** for applications in craniofacial indications [1-3].



Methodology

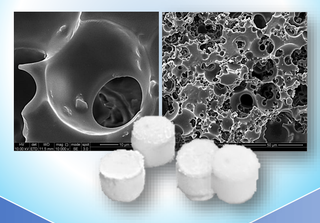
1. Synthesis of **HA** and **PCL**



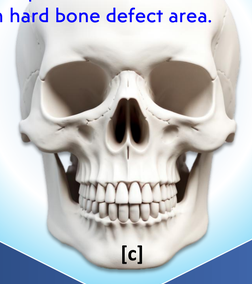
2. Design the **composite materials**



3. Fabricate **PolyHIPE scaffolds**



4. **Application:**
The implantable medical device to fill in hard bone defect area.



Purpose

- ❑ Develop **HA** or **HA-Zn** to cooperate with **PCLMA** in **composite materials; design** and **fabricate PolyHIPE scaffolds.**

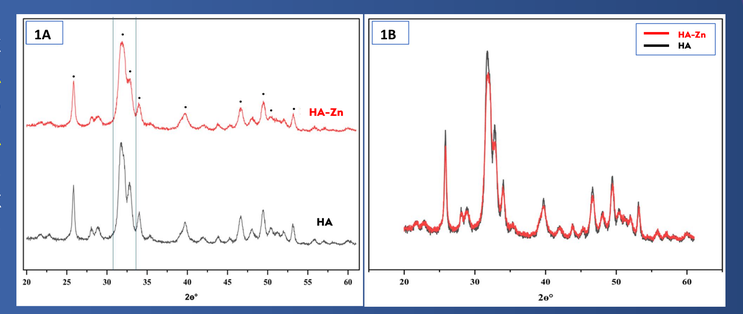
Objective

- ❑ To synthesise **HA** and **HA-Zn** including **PCL** using **a microwave -assisted method**.
- ❑ To create the **composite materials for designing** and **fabricating PolyHIPE scaffolds.**

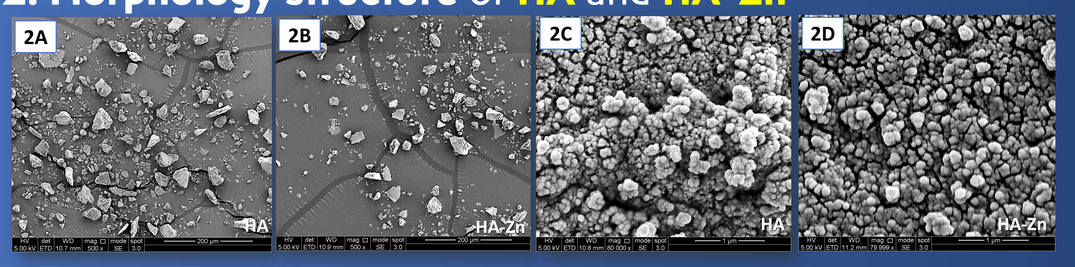
Result and Discussion

1. X- Ray Diffraction (XRD) Analysis **Crystallographic** of **HA** and **HA-Zn**

Comparison the peak patterns between **HA** and **HA-Zn**; **1A**) The peak diffraction of **HA** and **HA-Zn**, **1A** and **1B**). **The overlapped peak diffraction** between **HA** and **HA-Zn** (**1B**).

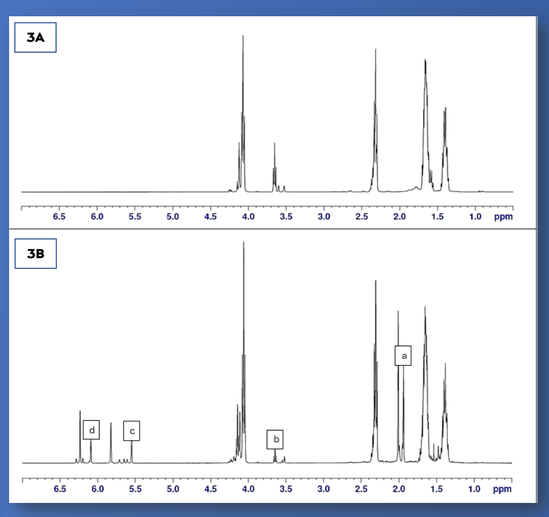


2. Morphology structure of **HA** and **HA-Zn**



Scanning Electron Microscope (SEM) images illustrate **the shape structure,** and **particle size** of **HA** and **HA-Zn; The morphology structure** of aggregated particles (**2A** and **2B**), Each apparent particle (**2C** and **2D**).

3. Nuclear Magnetic Resonance (NMR) of **PCL** and **PCL Methacrylate (PCLMA)**

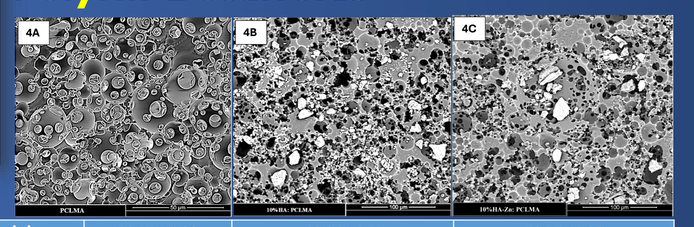


The peak **[b]** position at **3.6 ppm** is the peak of **the hydroxyl end (–OH)**. They were **not methacrylated**, whether these indicate the ends.

The peak **[a] [c] [d]** positions at **1.9, 5.5,** and **6.1 ppm**, respectively, were the peaks of **the methacrylate group.**

These peaks, appearing only in the **PCLMA**, can serve as evidence of **the methylation reaction**.

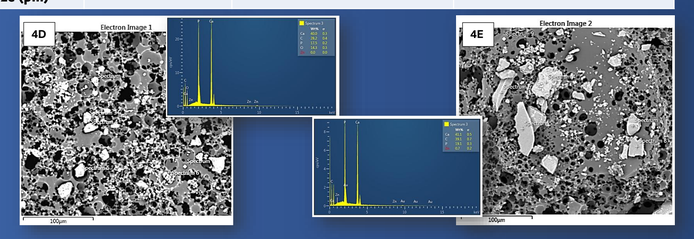
4. Morphology structure of **PolyHIPE scaffolds**



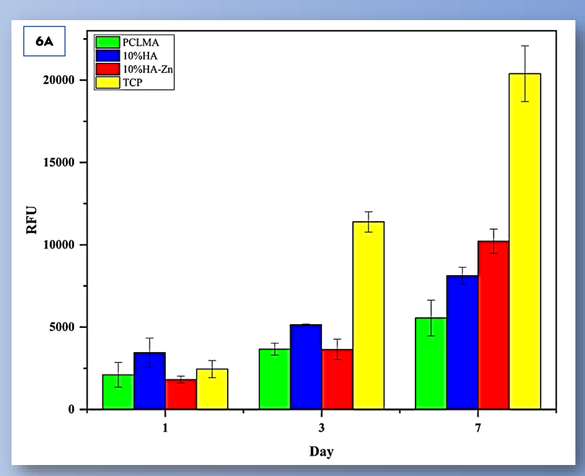
Porosity(%)	**72.17 ± 4.08**	**68.24 ± 1.51**	**70.53 ± 1.29**
Pore size (μm)	**15.55± 5.00**	**15.78±6.42**	**16.56± 4.6**
Inter connection pore size (μm)	**4.97±1.63**	**4.84±2.37**	**3.90±1.50**

SEM images exhibit **the shape structure, micropores,** and **interconnected pores** of **PolyHIPE scaffolds; PCLMA, 10%HA: PCLMA** and **10%HA-Zn : PCLMA** (**4A – 4C**) respectively.

Moreover, **SEM-EDS** prove the **element compositions** of **10%HA: PCLMA** (**4D**) and **10%HA-Zn: PCLMA** (**4E**)



6. Cell proliferation of **polyHIPE scaffolds**



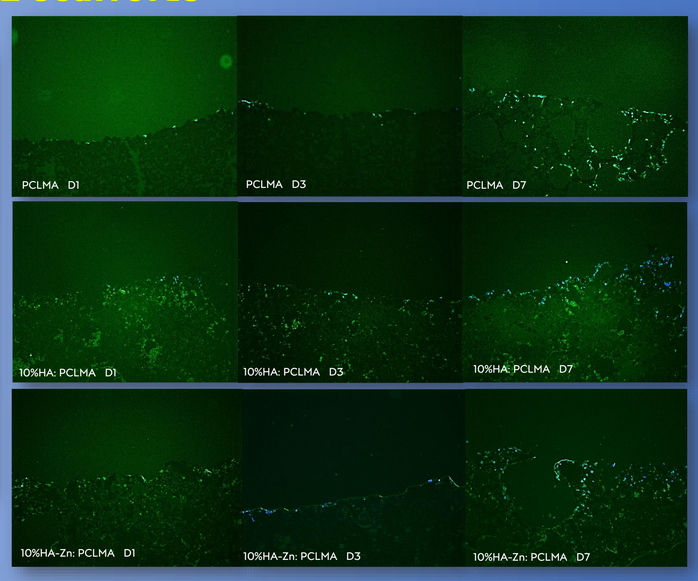
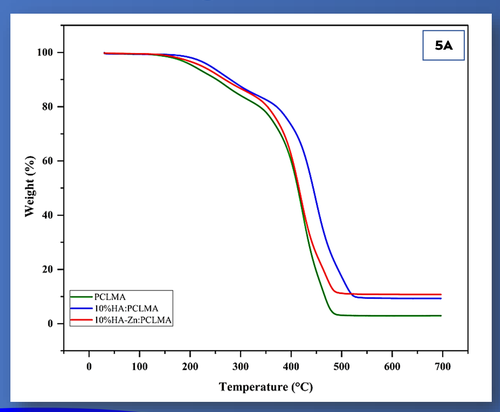


Figure 6A shows **the cell proliferation** of various conditions **polyHIPE scaffolds**; **PCLMA**, **10%HA: PCLMA** and **10%HA-Zn: PCLMA** including **DAPI-FITC** images at **day1, day 3**, and **day 7**.

5. Thermogravimetric analysis (TGA) of **polyHIPE scaffolds**



TGA was used to investigate **the actual composition ratio** for adding the **bioceramic** part to the **polyHIPE scaffolds.** The graph (**5A**) illustrates the weight percentage of **PolyHIPE scaffolds**; **PCLMA**, **10%HA: PCLMA** and **10%HA-Zn: PCLMA**, respectively.

Conclusion and Future work

The PolyHIPE scaffolds of bioceramic composite materials exhibit higher **cell proliferation** than **PCLMA PolyHIPE scaffolds**. Therefore, this **appropriate property** impacts the development of **implantable medical devices**.

Bioceramic materials will be required to develop PolyHIPE emulsion for **3D printing** as **bone substitute scaffolds** using in-house produced photocurable polymers.

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References