

Synthesis and characterisation of novel chemically cross-linked hydrogel/bioceramic composites for bone tissue engineering applications

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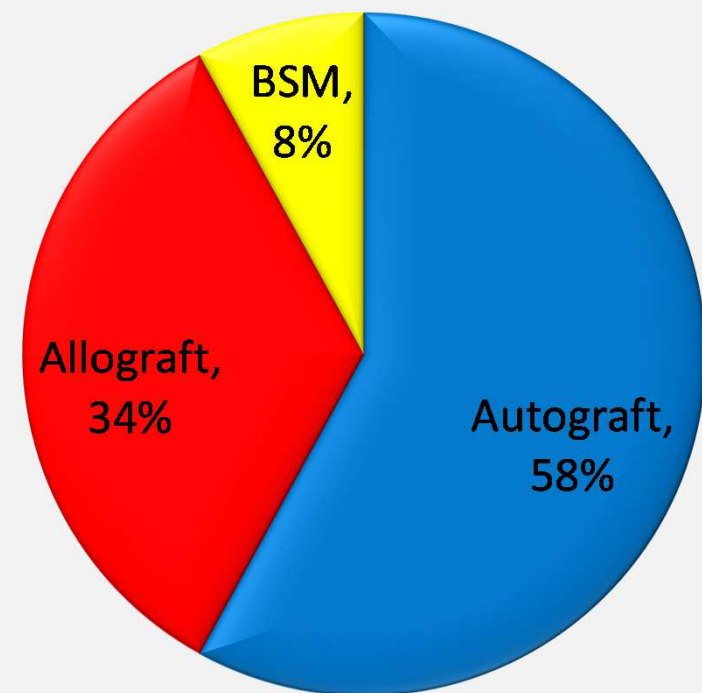


Short Term Scientific Mission



Introduction

- Bone
 - Good at repairing itself
 - Unless the injury is a critical size defect
- Bone tissue engineering
 - Increasingly important due to ageing populations
- Types of defects
 - Osteomyelitis
 - Osteosarcoma
 - Congenital femoral deficiency
- Current treatment options
 - Autograft
 - Allograft
 - Bone substitute materials



Objectives

Material for bone regeneration

Biocompatible
Biodegradable
Reabsorbable
Bioactive
Osteoconductive
Osteoinductive

Polymers and
hydrogels

PEGMDA
AA

- ✓ Mechanical and swelling properties
- ✓ Drug delivery
- ✗ No bioactivity
- ✗ Low resistance to compression

Ceramic materials

β TCP
 α Wollastonite

- ✓ Provide bioactivity
- ✓ Improve mechanical properties
- ✗ Brittle

Synthesis and Processing

Ceramic scaffold

- ❖ 20% β TCP
- ❖ 80% α Wollastonite



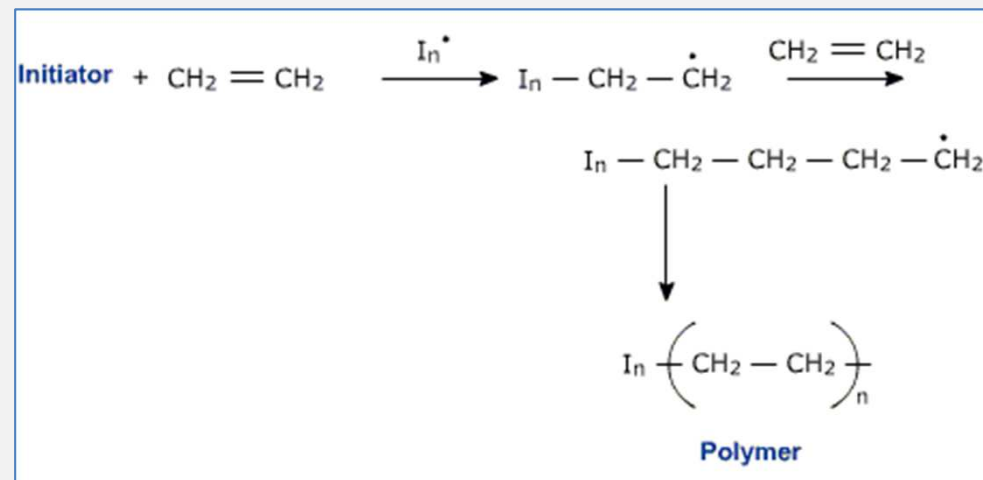
Monomer solution

- ❖ PEGDMA
- ❖ AA
- ❖ Distilled water
- ❖ Irgacure 2959

Hydrogel/Bioceramic composite

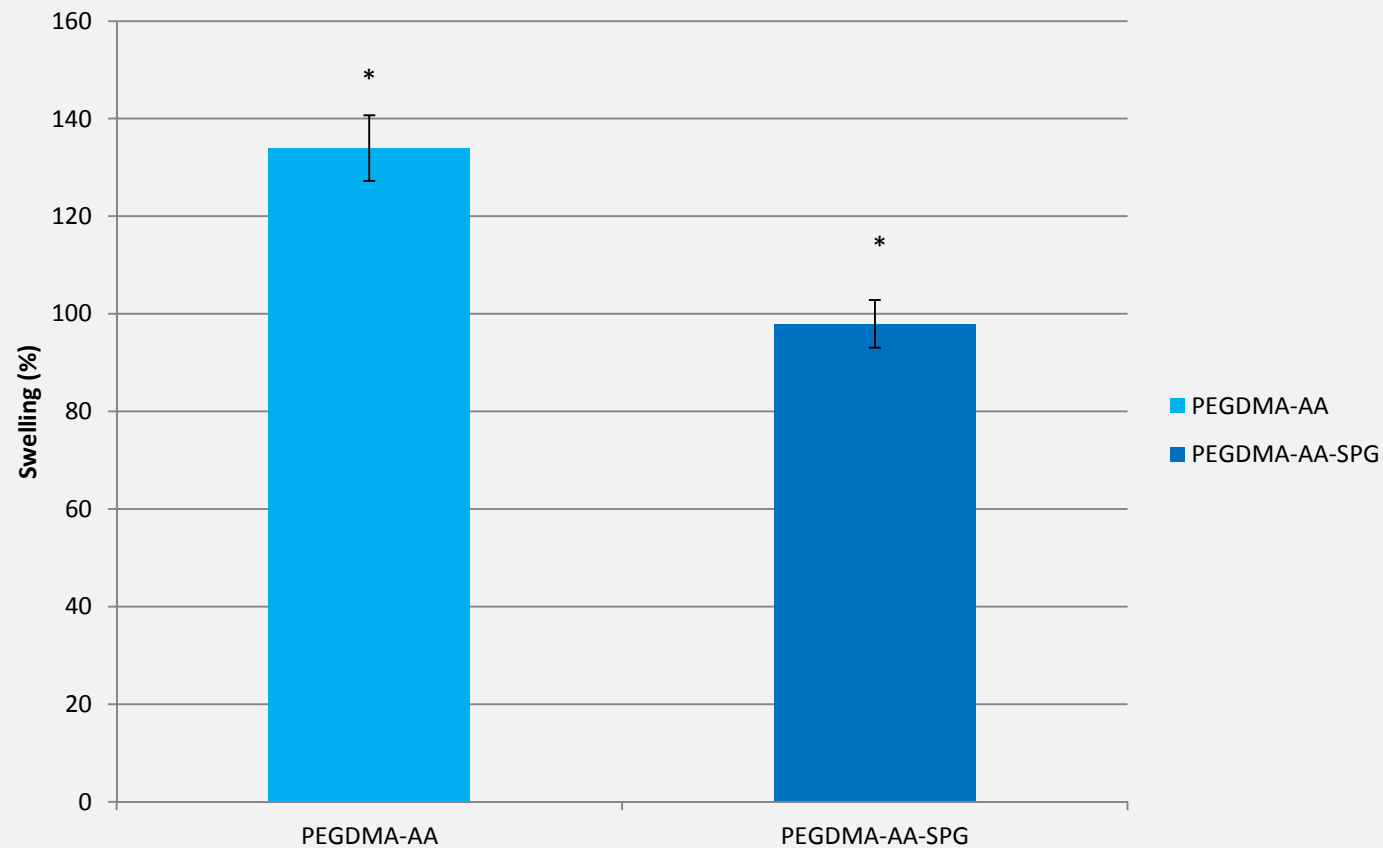
Synthesis and Processing

Free radical UV photopolymerisation

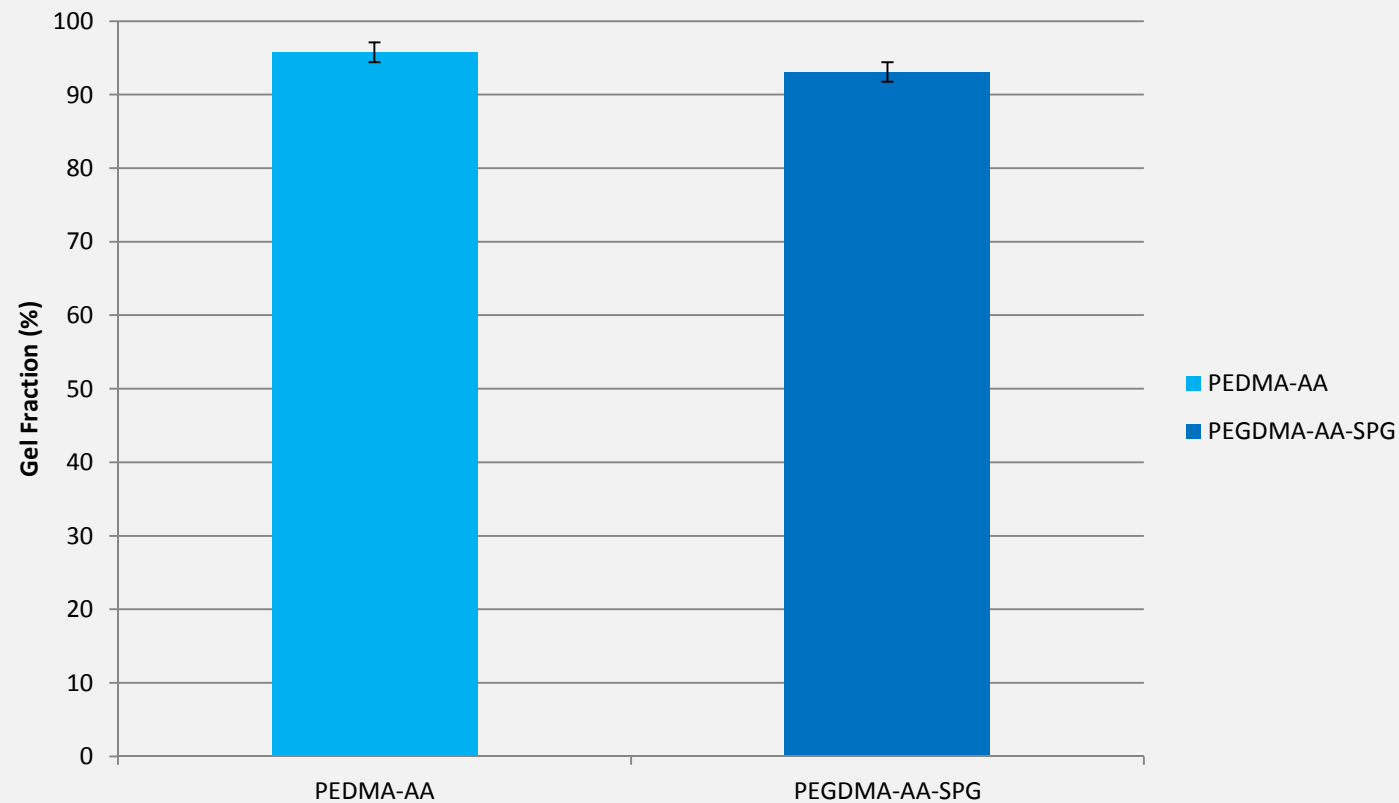


Hydrogel name	PEGDMA in water	Irgacure 2959 (wt%)	AA (wt%)	Ceramic scaffold
PEGDMA-AA	50:50	0.1	8	No
PEGDMA-AA-SPG	50:50	0.1	8	Yes
SPG	n/a	n/a	n/a	Yes

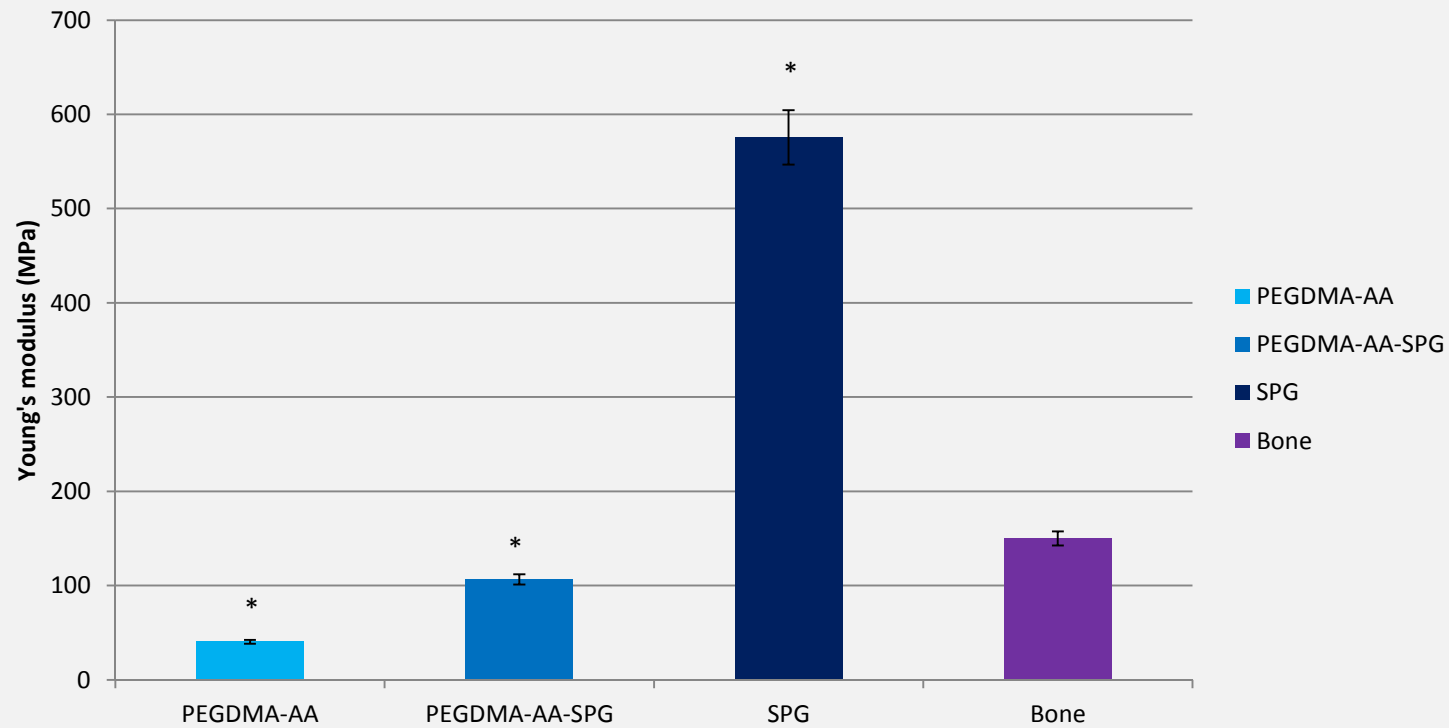
Results - Swelling



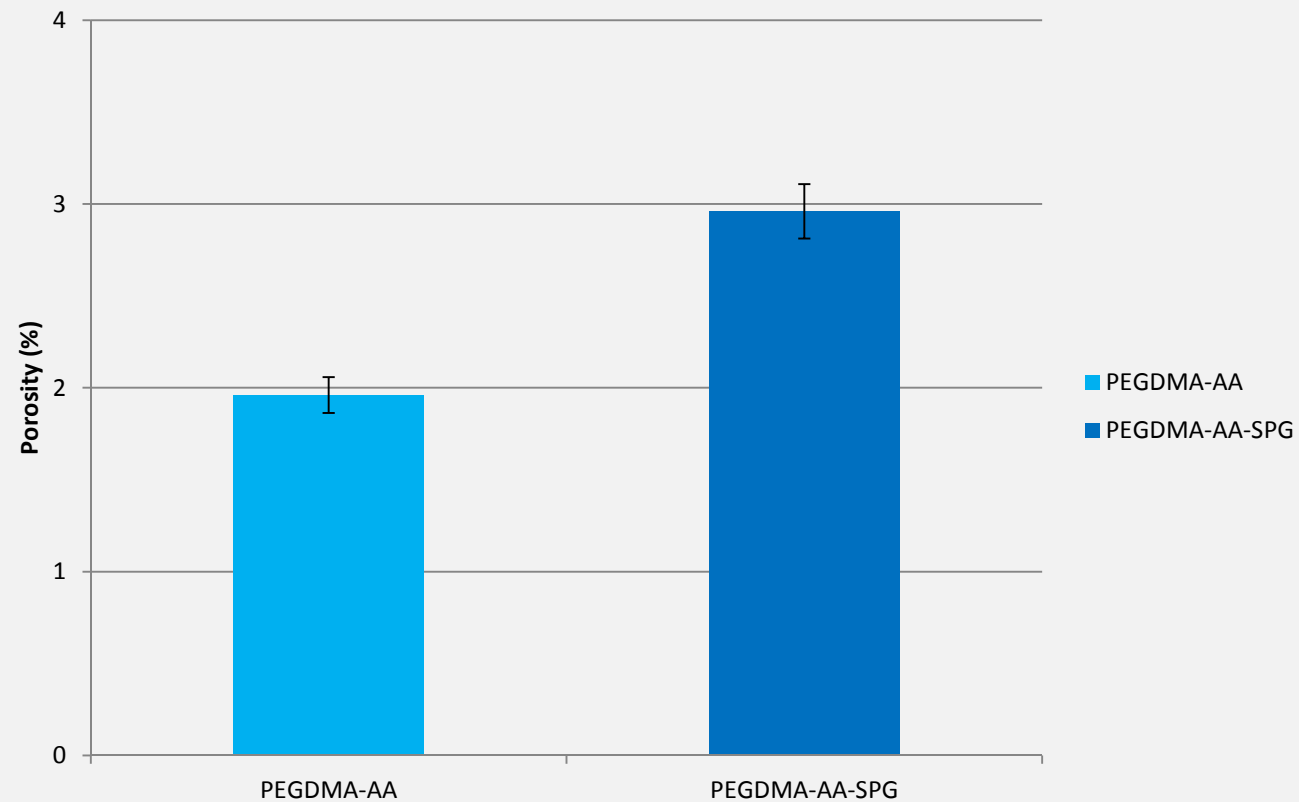
Results – Gel fraction



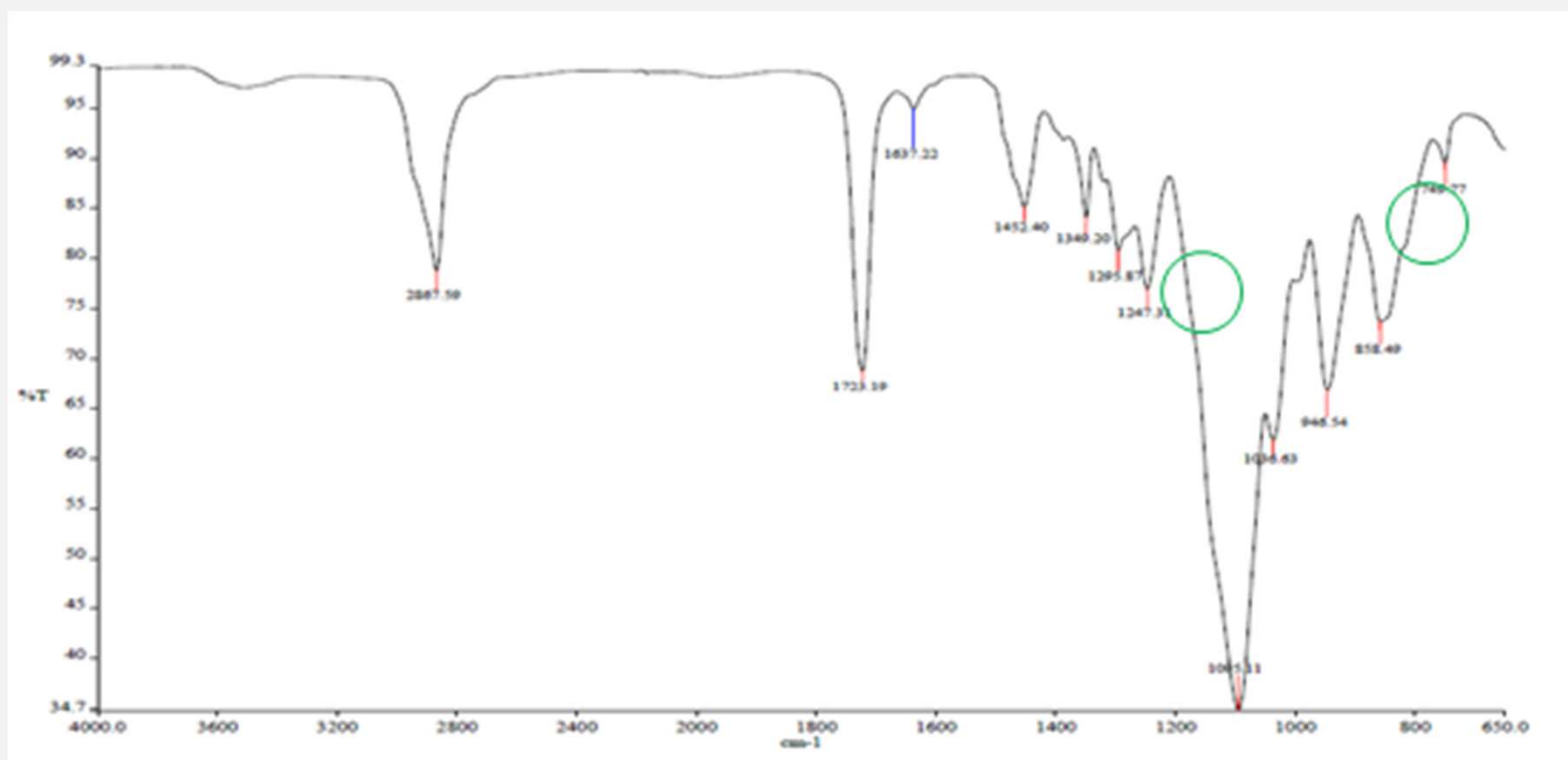
Results - Compression



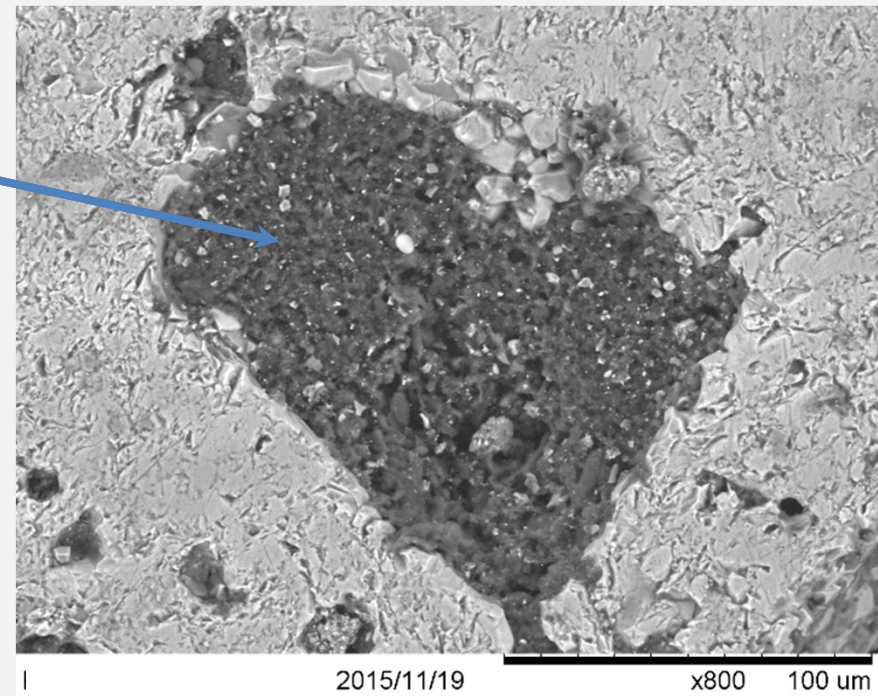
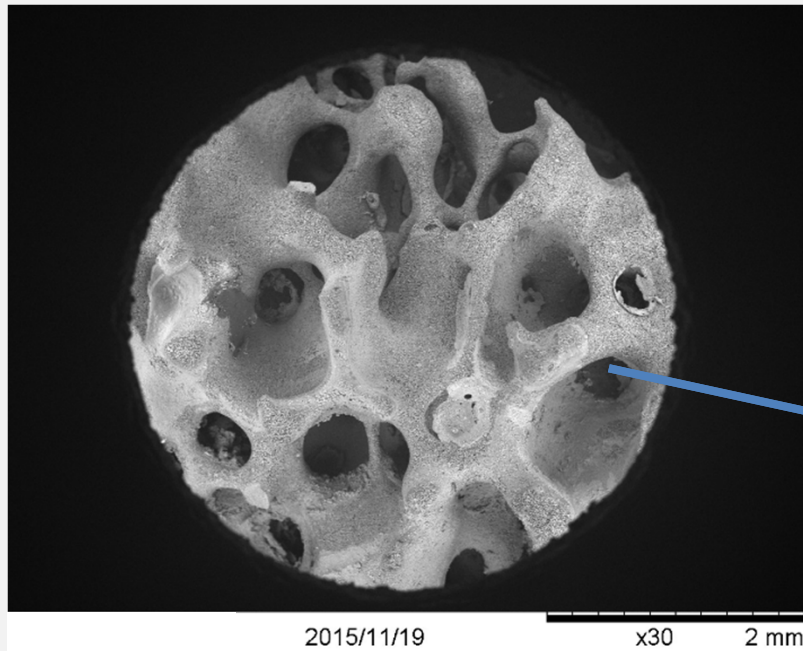
Results - Porosity



Results - FTIR



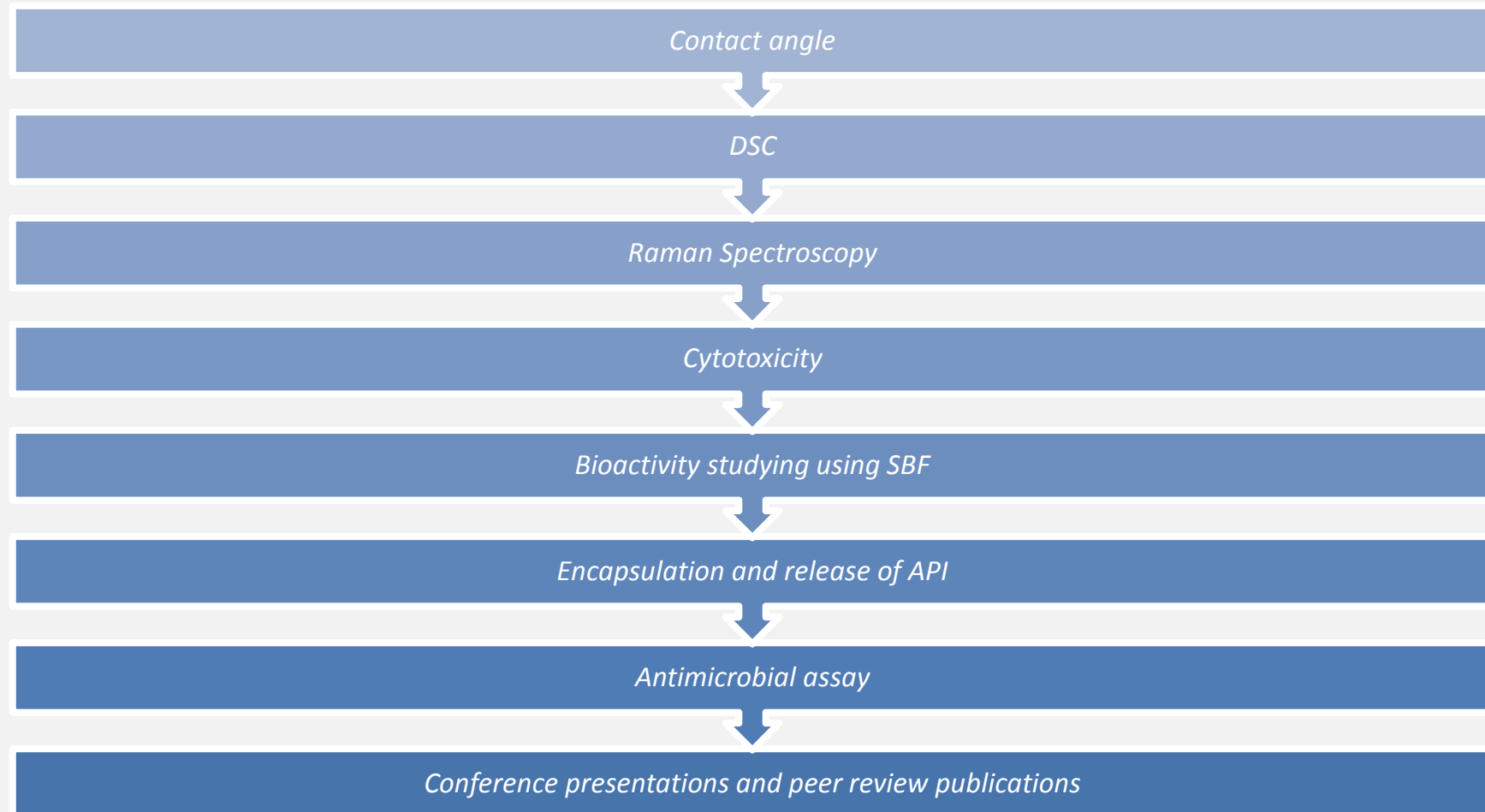
Results - SEM



Recap

- Reduction in swelling when comparing control hydrogel to the composite
- No change in gel fraction percentage
- Compression results favourable for load bearing bone applications
- SEM analysis illustrated that the polymer had penetrated the ceramic scaffold
- Successful fabrication of a bone substitute material which has the advantages of the bioceramic scaffold and the polymer; together they overcome the limitations of either individual component to produce a potential BSM

Future work



Acknowledgements



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Thank you

