NOVEL FABRICATION METHODS FOR (LOW TEMPERATURE) THERMOFORMABLE COMPOSITES INTENDED FOR MEDICAL APPLICATIONS

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Abstract

A novel SRIM-style process – monomer transfer moulding (MTM, Figure 1) - has been developed for reactive processing of poly-epsilon caprolactone (PCL) composites for bone replacement or fixation. Caprolactone monomer is catalysed using stannous octoate and polymerized in-situ within a closed mould. The material combines the important potentials for low temperature thermoforming with safe resorption in a clinical context. The laboratory scale process also facilitates the introduction of functional additives to control the rate of resorption (Figure 2). The latter can be adjusted to take buffering and tissue regrowth into account. Here we present data on the processing and performance of completely resorpable systems based upon novel, high modulus phosphate glass fibres and on high performance, durable systems based on carbon reinforcements. The first category covers the screening of a range of ternary and quaternary phosphate glasses melt drawing into 15 micron fibres (Figure 3), the screening of coupling agents and fabrication of plane random and unidirectionally reinforced test coupons for durability testing. In the second context, we compare the effectiveness of our reactive processing route with a traditional approach based upon film stacking – very significant enhancements in mechanical properties are highlighted via MTM (Figure 4) and these are investigated by mechanical testing, microstructural characterization and fractography. A single fibre fracture test is applied to assess the relative interfacial bonding efficiencies and a fabrication method is developed to produce in-situ polymerized specimens. Finally, the properties of candidate boneplate materials are examined with respect to in-theatre thermoforming and its impact on structural integrity.

References:

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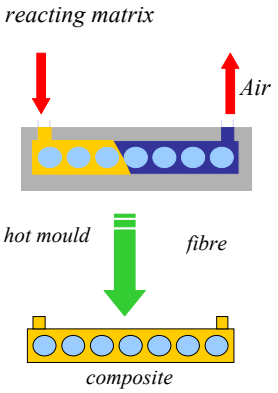

Figure 1 Schematic diagram of process.

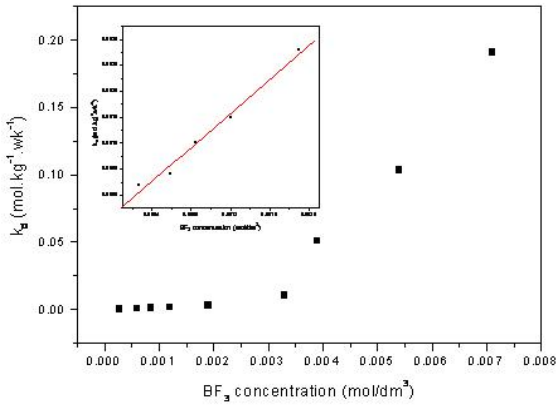

Figure 2 Effect of BF3 loading on PCL Mw
Jiang G. PhD thesis, 2004

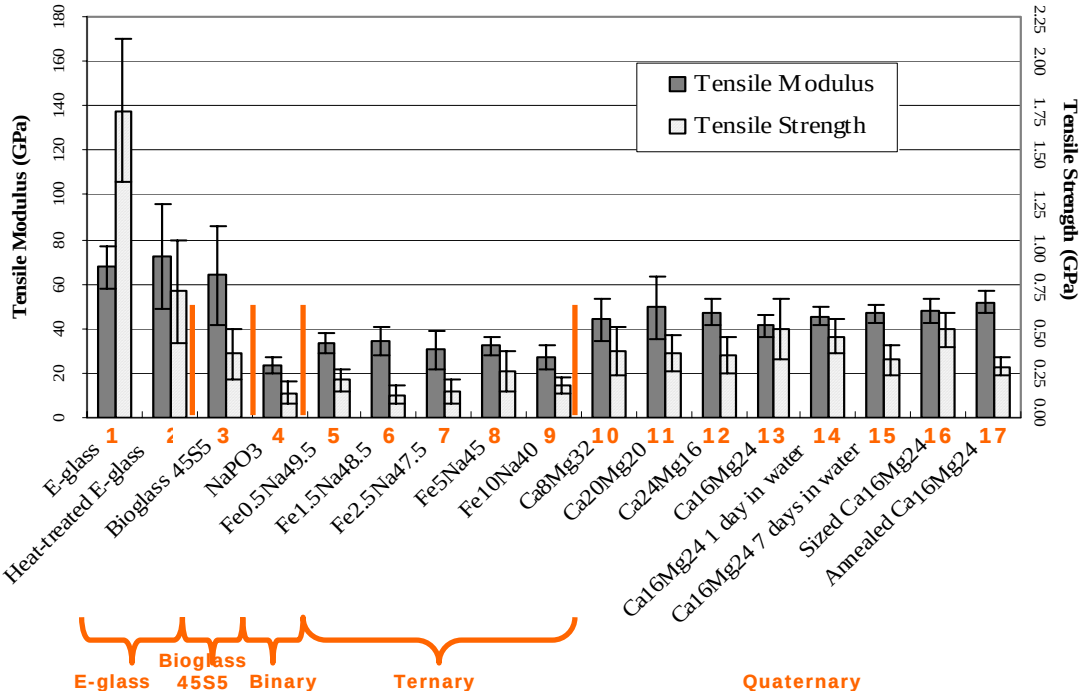

Figure 3 Selected fibre properties.

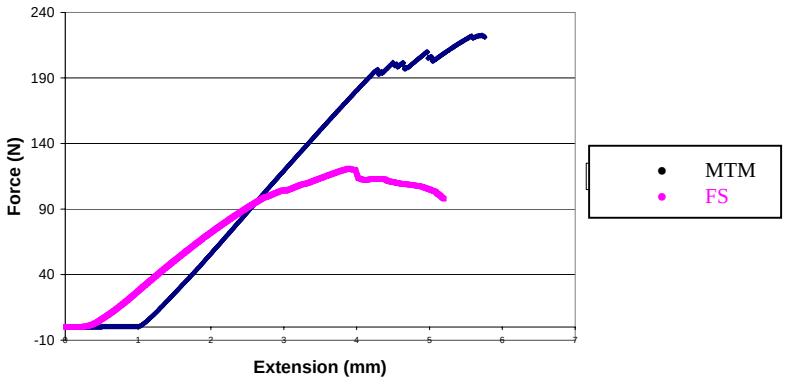

Figure 4 FS vs. MTM properties.