



## IN-SITU STUDY OF THE FRACTURE BEHAVIOUR OF BIOINSPIRED ALUMINA-BASED COMPOSITES WITH DIFFERENT COMPLIANT POLYMER PHASES

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# Background



- Dental crowns are prosthetics used to replaced damaged or missing teeth
- All-ceramic crowns, usually made of alumina or zirconia, are popular choice due to almost natural aesthetics
- Dental ceramics are harder and stiffer than natural teeth and tend to have low fracture toughness
- Introduction of a polymer phase in combination with a bio-inspired microstructure can create materials that are softer, less stiff, with higher fracture toughness

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## **Methods**



- Nacre-like alumina scaffolds were manufactured using a bidirectional freezecasting technique
- 4 groups of 60% ceramic composites were prepared – PMMA, Epoxy, UDMA, and PU
- Cyclic and monotonic fracture toughness tests were performed using in situ SEM 3point bending
- R-curve behaviour was determined according to the ASTM E1820 standard



Fig. 1 Diagram of the bidirectional freeze-casting process. Algharaibeh et al. J Eur Ceram Soc, 39:2-3 (2019): 514-21



Fig. 2 3-point bending fracture toughness tests were performed using a Deben Microtest stage inside a Tescan MIRA II.



- PMMA > Epoxy > UDMA > PU
- *K<sub>Jc</sub>* values measured using cyclic testing ranged from 6.11±1.14 11.37±2.4 MPa.m<sup>0.5</sup>
- *K<sub>Jc</sub>* values measured using monotonic testing ranged from 8.51±0.23 12.12±2.23 MPa.m<sup>0.5</sup>



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Fig. 3: Representative load-displacement curves of monotonic and cyclic testing of 60% alumina-PMMA nacre-like composites.





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Thank you for your attention!