

Synthesis of Al₂O₃/Al Co-continuous* Composite by Reactive Melt Infiltration

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*A ceramic/metal co-continuous has the interconnecting empty spaces in the ceramic reinforcement filled with metal, thus providing continuity in both the metal and ceramic phases.

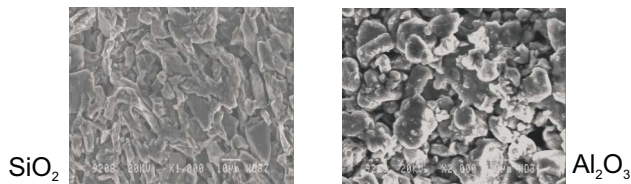
Objectives

- Using a Al₂O₃ preform, fabricate Al₂O₃/Al co-continuous composite by melt infiltration.
- Using a SiO₂ preform, fabricate Al₂O₃/Al co-continuous composite by melt infiltration involving chemical reaction to change SiO₂ to Al₂O₃.
- Compare the two processes of infiltration using scanning electron microscopy (SEM), energy dispersive x-ray microanalysis (EDS) and x-ray diffraction analysis (XRD).

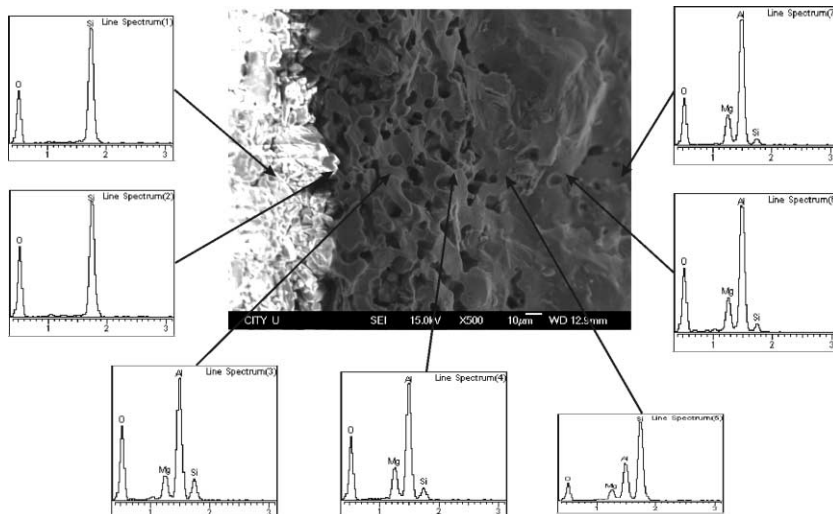
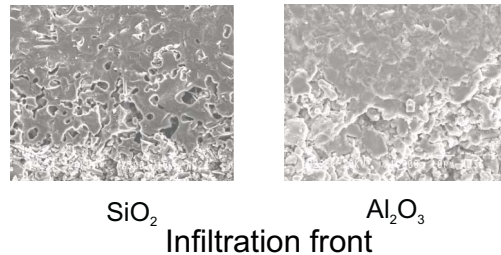
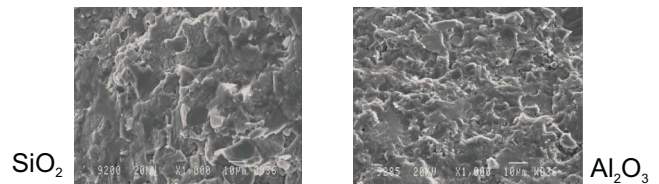
Major findings:

- Using a Al₂O₃ preform, the reaction $3\text{SiO}_2 + 4\text{Al} \rightarrow 2\text{Al}_2\text{O}_3 + 3\text{Si}$ Occurred at the infiltration front, and generated a transition zone containing a new type of interconnecting porosities of about 100μm in width. The reaction continued with further infiltration of molten aluminium alloy into these porosities and reaction with residual SiO₂ until all the SiO₂ are transformed into Al₂O₃.
- Reactive melt infiltration took place at a higher rate for the SiO₂ preform than that for the direct infiltration of the Al₂O₃ preform.
- The fracture surface examination demonstrated the toughening effect provided by the continuous aluminium alloy in the composite.

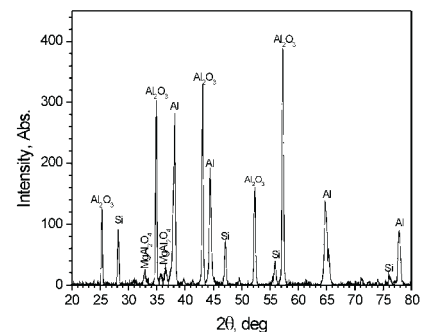
Preforms



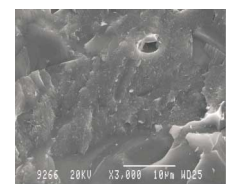
Finished Composites



EDS analysis across infiltration front, showing transformation from SiO₂ to Al₂O₃



XRD analysis of SiO₂ preform, showing transformation from SiO₂ to Al₂O₃



fine ductile metal distributed in the resulted Al₂O₃