Grain boundary phase and microstructural study on non-oxide Si$_3$N$_4$ ceramics

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Abstract: Engineering ceramics are often difficult to prepare for observation because of their hardness, wear resistance and chemical inertness. Different silicon nitride containing Y$_2$O$_3$ and Al$_2$O$_3$ are prepared and etched using several different techniques and the most efficient methods are identified. The microstructure and grain-boundary composition were examined by electron microscopy (SEM, TEM), electron diffraction and energy-dispersive X-ray microanalysis. A method has been developed to quantify microstructure consisting of elongated, rod like β-grains to discuss the interdependence between starting materials composition, processing condition, microstructure and resulting mechanical properties of dense Si$_3$N$_4$ materials. It is shown that post-sintering heat-treatment in air in the temperature between 1100-1450 °C results in substantial crystallisation of the glassy phase.

Keywords: Thermal, chemical and plasma etching, microstructural parameters, Grain boundary phase crystallization