The characterization of SiAlON-TiN composites using analytical transmission electron microscopy techniques

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Although SiAlON ceramics exhibit considerable engineering properties, recent studies have been carried out to further improve its properties by means of adding such as SiC, TiN and TiCN into SiAlON ceramics [1-2]. Since TiN especially demonstrates numerous attractive properties involving high hardness, good chemical durability and high electrical conductivity as well as its concurrency with Si_3N_4, it is used as particulate additive into SiAlON matrix to form composite structures for a variety of applications [3-6].

The aim of present research is to investigate the distribution and interactions of TiN with SiAlON grains. Electron transparent samples for analytical transmission electron microscopy (TEM) investigations were prepared by cutting, polishing, dimpling and finally ion beam thinning (Baltec RES 101). The prepared samples after coating (Baltec MED 020) with a thin carbon film were characterized by using 200 kV field emission transmission electron microscope (JEOL 2100F) attached with an energy filter (GATAN GIF TRIDIEM), parallel electron energy loss spectrometer (PEELS), a high angle annular dark field scanning transmission electron microscope (STEM-HAADF) detector and an energy dispersive x-ray (EDX) spectrometer (JEOL JED-2300T). Furthermore, during acquisition of EFTEM-SI-EELS and STEM-SI-EELS elemental analysis a drift corrector was used.

The STEM-HAADF image shown in Figure 1 (a) indicates the different phases present in the microstructure. In this image, TiN grains seen as white particles were distributed homogenously in the composite system. Based on STEM-EDX point elemental analysis results shown in Figure 1 (b) acquired from triple junction secondary phases and β-SiAlON grains corresponding to grey and black regions, respectively, in Figure 1 (a), it could be deduced that Ti diffused into triple junction secondary phase composition and also incorporated to β-SiAlON structure.

In figure 2 (a-e), EFTEM 3-window elemental mapping results are shown for Si-$L_{3,2}$, N-K, Ti-$L_{3,2}$, O-K, Al-K and Y-$L_{3,2}$ edges, respectively. The results are confirming the STEM-EDX analysis that Ti does exist at triple junction phase and in β-SiAlON grains.

1. C. Santos et al., J. Mater. Process. Techn.**189** (2007) p138.
2. X. Jianguang et al., Ceram. Inter. **32** (2006) p599.
3. Z. Zhao et al., Mater. Res. Bull. 37 (2002) p1175.
4. X. Fangfang et al., Mater. Let. 34 (1998) p248.
5. A. Feldhoff et al., J. Eur. Cer. Soc. 25 (2005) p1733.
6. L. Wenkui et al., Cer. Inter. 31 (2005) p277.

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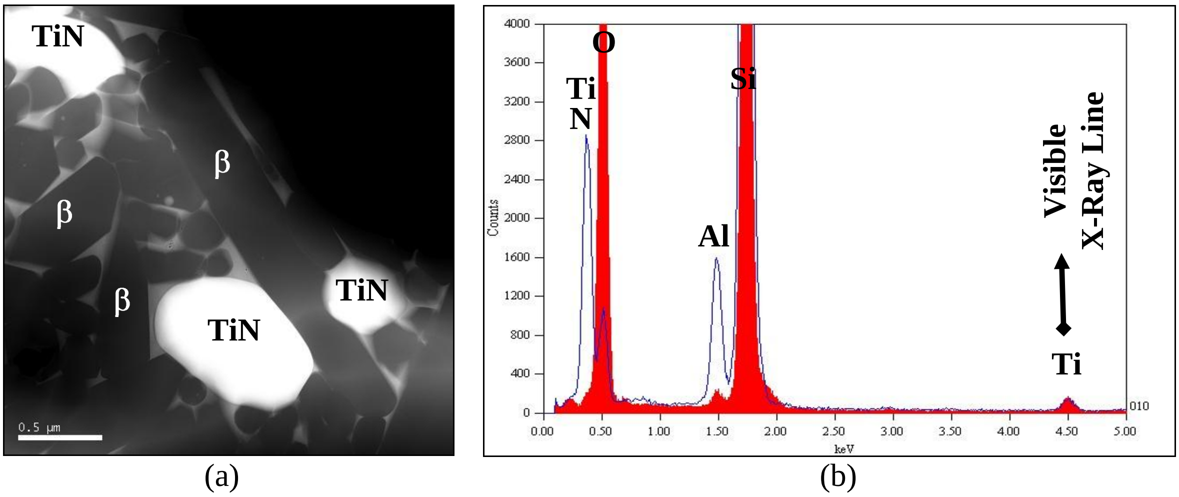

Figure 1. (a) STEM-HAADF image of TiN-SiAlON composite, (b) STEM-EDX point analysis of triple junction secondary phase (red filled spectrum) and β-SiAlON grain (blue line spectrum).

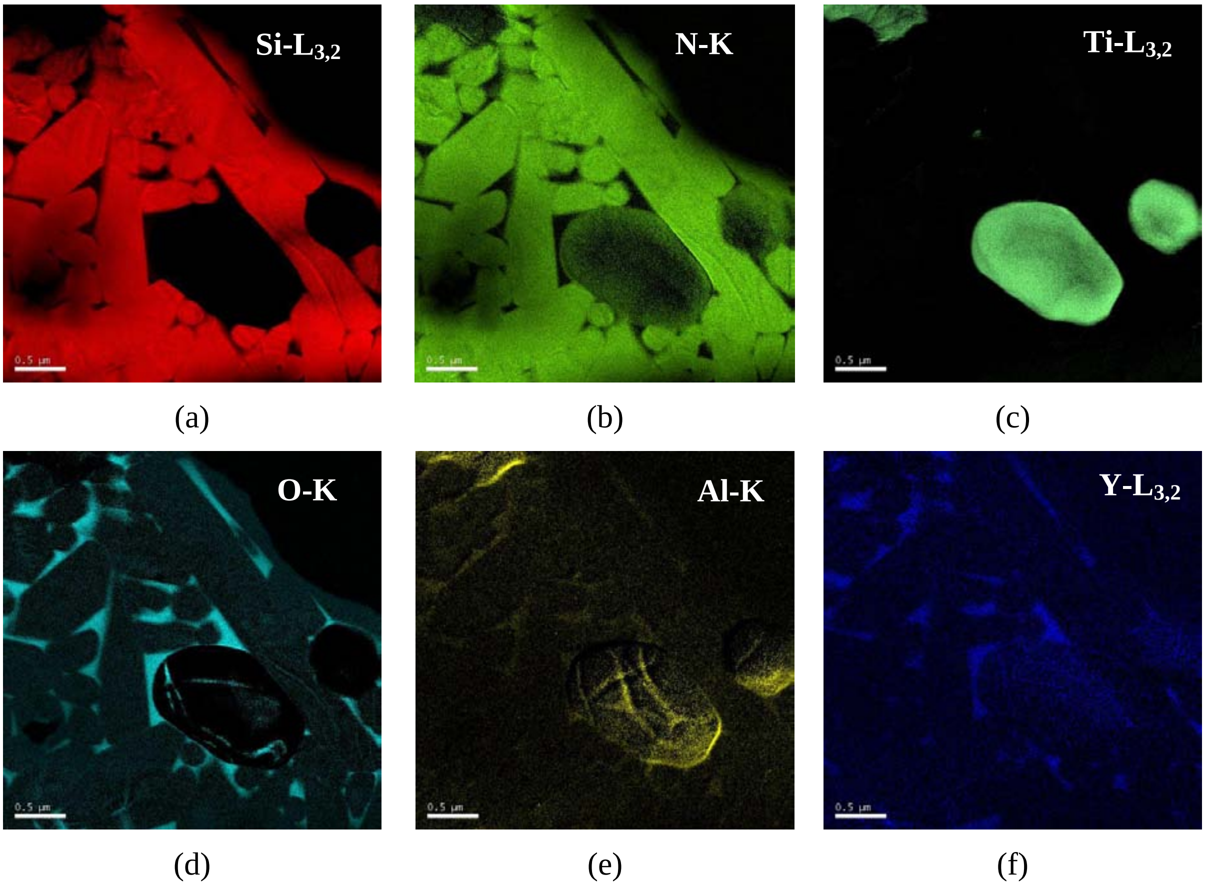

Figure 2. (a-f) EFTEM 3-window elemental mapping results for $Si\text{-}L_{3,2}$, N-K, $Ti\text{-}L_{3,2}$, O-K, Al-K and $Y\text{-}L_{3,2}$ edges, respectively.

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