MXENE-BASED CERAMIC NANOCOMPOSITES ENABLED BY FIELD-ASSISTED SINTERING

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MXene materials have gained widespread attention due to their versatility, and there is increasing interest in incorporating them into metal or ceramic matrices to create advanced nanocomposites. In this study, we present a facile approach for the production of bulk MXene/ceramic nanocomposites through the mixing of MXene with ceramic particles followed by field-assisted sintering. The $Ti_3C_2T_z$/alumina system was used as a model to investigate the effect of MXene addition on the densification behavior and properties of nanocomposites. Our results show that the presence of MXene significantly enhances the densification rate at low temperatures and leads to a homogenous distribution of $Ti_3C_2T_z$ MXENE at the alumina grain boundaries. The obtained $Ti_3C_2T_z$/alumina nanocomposites exhibited electrical conductivity and strong light absorption, while the hardness decreased due to weakening of the grain boundaries caused by the presence of intergranular layered MXene. Additionally, we demonstrated that using multilayered $Ti_3C_2T_z$ as a precursor can produce composites with plate-like TiC_x morphology. We suggest that the processing methods proposed in this work are applicable to metals and other widely used ceramics. MXene type, size, composition, and termination groups could be engineered and adapted to most oxides, nitrides, or carbides depending on the desired properties. This work provides a conceptual approach for utilizing the diversity and versatility of MXene in the creation of tunable advanced nanocomposites.

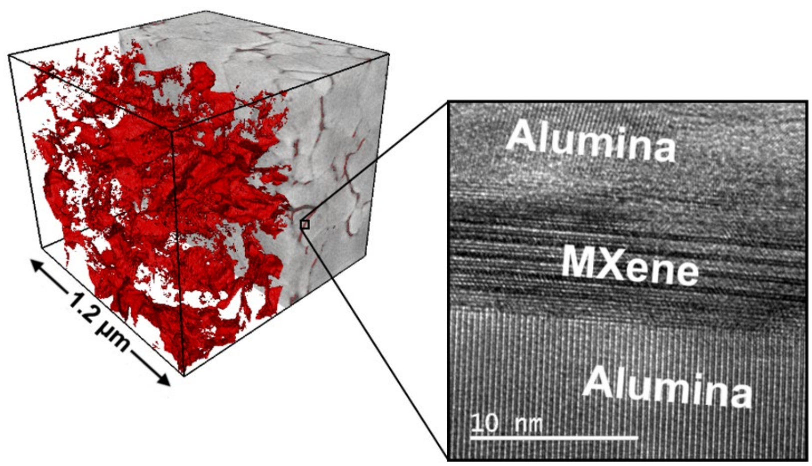

Figure 1 – FIB tomography 3D reconstruction of the MXene network and a magnified high-resolution TEM micrograph of several $Ti_3C_2T_z$ MXene layers integrated at the grain boundary between two Al_2O_3 grains