東京大学グローバルCOEプログラム　機械システム・イノベーション国際拠点

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Evolution of Intergranular Film to Initiate Grain Growth in Ceramics

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要旨

Additive-microstructure correlation in many ceramic systems has been thoroughly investigated over decades, but mainly on a global level and in a statistic sense. On the other hand, the ubiquitously present intergranular films (IGF) were frequently found to have equilibrium thickness which is independent to crystallography of grain surface but subjected to the global chemistry. Recently such stable amorphous grain boundary structures were assembled into a scheme of “complexions” that leads to the establishment of an interfacial phase diagram, hence the microstructure development could be rationalized as initiated from transitions between various “complexions”.

However, such a picture does not take into account of variation of IGF chemistry within a given microstructure and the underline crystallographic factors from the adjacent grains, both were hard to be ignored by systematic experiments or by careful reasoning. Indeed, over the past 15 years we observed such chemical variations in IGF in practically every ceramic system with various microstructures, even though the underlining mechanisms varied from one case to another.

Here I would like to present two model systems, low-CaO-doped Si_3N_4 and low-TiO_2/SiO_2-doped Al_2O_3 ceramics, both reveal not only rather peculiar behaviors of IGF chemistry but also strong connections with grain morphology and facets. More interestingly, both systems witness a transition from uni-modal to bi-modal microstructures, and such transition occurred primarily due to the compositional evolution of IGF at specific facets. In both cases the relatively larger multi-grain pockets play a key role as supplier or reservoir.

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