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Growth mechanism of in-situ WC grain in Fe-Ni-W-C alloys system

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Abstract: In-situ WC grains were synthesized by using in-situ metallurgical reaction in W-Fe-Ni-C alloys system. The growth mechanisms as well as the coarsening process of WC grains were analyzed by XRD, SEM and *ab initio* calculation. Results show that the morphology evolution of in-situ WC growth unit evolves from sphere-like → icosahedron → octahedron → truncated-octahedron → flat-tri-prism. The final flat-tri-prism is bound by two basal facets {001} and three prismatic facets $\{\bar{1}10\}$. In short, the growth process of in-situ WC grain includes two independent stages, one is the formation of WC growth unit on basal facets {001}, and the other is the lateral stack of WC growth units in facets {001} as well as the vertical stack of WC growth units along <001> direction. Finally the in-situ WC grain grows into multi-layered triangular prism. The coarsening of in-situ WC grains, known as the Ostwald ripening, is partly due to the prior formed WC grains basal facets $\{\bar{1}10\}$ can act as the heterogeneous nucleus of other newly generated WC grains hence promoting the forming of in-situ WC nucleus. The excellent mechanical properties, such as high hardness and good toughness, of WC grain benefit from its growth characteristics.

Key words: Coating materials; Tungsten carbide; Crystal growth; Microstructure; In-situ synthesis; Scanning electron microscopy