Grain Growth during Sintering

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Abstract

Grains usually grow during sintering with or without a liquid phase. The grain growth mode may be either normal or abnormal. The normal growth is characterized by relatively narrow grain size distributions which are invariant with time when normalized to the average sizes. In abnormal growth, some grains grow to large sizes at certain stages. The abnormal growth has been attributed to the pinning effects of pores or second phases, but it occurs also in pore-free single phase systems with or without a liquid phase. Normal growth can occur also in the presence of pores during sintering.
Recent observations and theoretical analysis show that the grain growth mode depends on the structure of the related interfaces. Both solid-liquid interfaces and grain boundaries can be singular with flat shapes at low temperatures and undergo roughening transitions at high temperatures to curved shapes. Certain additives can also induce the interface roughening or the reverse transition. The grain growth mode gradually changes from normal to abnormal if the temperature or the additive content changes gradually. The interface roughening transition is also expected to influence the sintering process. The observations of interface roughening and grain growth have been made in metals, carbides, and oxides.