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Re-examination of the $\beta \rightarrow \gamma$ transformation of Ca_2SiO_4

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Abstract

Dicalcium silicate finds applications in different fields (cement, bio-ceramics, refractories). In the case of Portland cement, its interest is its lower sintering temperature compared to tricalcium silicate and therefore an interesting compound for low CO_2 cements. Dicalcium silicate goes through different polymorphic forms, namely α , α'_H , α'_L , β and γ , as the temperature decreases. In theory, only the γ -phase is stable at room temperature. In a polycrystalline material, the different polymorphs can co-exist depending on several factors (sintering conditions, presence of impurities, grain size) and the interpretations given in the literature are sometimes contradictory. For cement applications, only the α , α' or β polymorphs react with water to give hydrates while γ does not. Therefore, this paper focuses specifically on the effect of grain size on the β to γ transformation. We also propose that the transformation is semi-reconstructive and not martensitic as suggested by some authors.

1. Introduction

Dicalcium silicate finds applications in different fields (cement [1-2], bio-ceramic [3], biomedical engineering [4], composite refractories [5]). It is considered as a major component of Portland cement [6]. The interest in dicalcium silicate is its lower sintering temperature compared to tricalcium silicate [7-9].

Dicalcium silicate (Ca_2SiO_4) belongs to orthosilicate family [10]. The structural changes in Ca_2SiO_4 crystals have been reported by different researchers [11-14]. Ca_2SiO_4 crystals presents five polymorphic forms, namely α , α'_H , α'_L , β and γ , as the temperature decreases [12]. In theory, only the γ -phase is stable at room temperature. However, in a polycrystalline material,

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