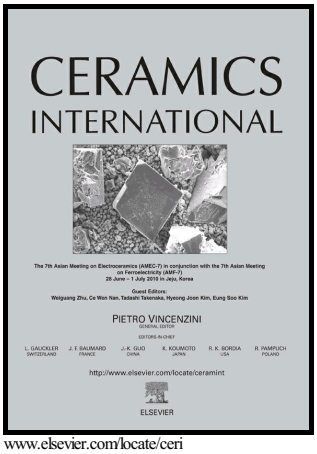

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Effects of added polyvinyl pyrrolidone on morphology and microstructure of multiple-phase mullite nanofibers

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Abstract:

In this study, mullite nanofibers with smooth surface and dense structure were successfully fabricated with various amounts of polyvinyl pyrrolidone (PVP) as polymer template using electrospinning. To optimize properties of mullite nanofibers, effects of PVP content on the morphology and microstructure of the nanofibers were investigated. Results show that the nanofibers were composed of multiple phases (including nanocrystalline mullite, Al-Si spinel, and amorphous phase), and all had good flexibility. When PVP content increased, diameters of the fibers decreased. Meanwhile, mullite grain size and phase content increased, which led to changes in mechanical properties. Also, it was revealed that removal of PVP polymers (which helps atom diffusion and promotes nucleation-growth of mullite) was the acceleration mechanism of the additives. From analysis of crystallization activation energy and chemical structure, clear picture of the acceleration mechanism is gained, and this can provide a guideline for future optimization of electrospinning processes for high-temperature ceramics nanofibers.

Keywords: Mullite; Electrospinning; Nanofibers; Microstructure; Polyvinyl pyrrolidone

1 Introduction

Electrospinning is a remarkably simple method for producing continuous nanofibers including polymers and ceramics [1, 2]. A number of metal oxides, including mullite ($3Al_2O_3 \cdot 2SiO_2$), has been fabricated as fibrous