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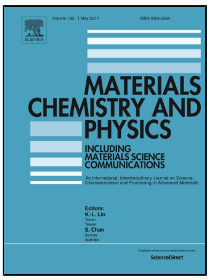

Sintering and Annealing Effects on Undoped Yttria Transparent Ceramics

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Sintering and Annealing Effects on Undoped Yttria Transparent Ceramics

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ABSTRACT

Transparent yttrium oxide (Y_2O_3) ceramics were processed by several densifications steps without any doping species. The green bodies were obtained by the aqueous way and sintered at high temperature under vacuum and then under high pressure. We studied the effects of different sintering cycles and air annealing at different steps of the process on the density and the grain growth. We also focused on the reaction between yttria ceramics and BN-coated graphite crucible which occurs during HIP. We noted that a low heating rate and two annealing steps are necessary to improve our samples' transparency.

KEYWORDS: YTTRIA, SINTERING, AIR ANNEALING, HIP, TRANSPARENT CERAMICS.

1. INTRODUCTION

Yttria transparent ceramics have been widely used as host materials in laser applications, IR windows or domes because of their interesting properties. Indeed, Y_2O_3 has a high melting point at 2462 (+/-19) °C which is required in high temperature applications. Moreover, the corrosion resistance and the toughness are part of yttria transparent ceramics advantages. Nevertheless, the main asset of these ceramics is their large transparency range in UV-Vis and IR (0.25 to 9µm) that is larger than in spinel or alumina [1]. Several methods exist to process yttria transparent ceramics. The green bodies can be formed by an uniaxial pressing [2] or by the aqueous way [3]. Then, to reach the full density and thus a high transparency, green bodies are sintered. There are many ways to carry out the sintering. It is possible to use vacuum [4,5,6,7] or air treatments [8]. The advantage of a vacuum method is that it prevents the gas bubbles entrapment inside the ceramic, which are impossible to remove. Finally, the total density is often reached with a Hot Isostatic Pressing (HIP) treatment [1,5,8, 9]. Other researchers obtained yttria transparent ceramics by other processes like Spark Plasma Sintering (SPS) [10]. In some cases, air annealing treatments can be performed to restore the oxygen content that is depleted during vacuum sintering and hot isostatic pressing [4,6,7,11]. According to our experience and our equipment capabilities in transparent ceramics processing [3,12], the different steps of our process are: slurry with high powder ratio and its filtration to obtain green bodies; drying; vacuum sintering and Hot Isostatic Pressing. Air annealing steps are also parts of the process.

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