The Institution of Engineers, Malaysia

BEM Approved CPD: 2
Ref. no: IEM23/HQ/195/T (w)

WEBINAR TALK ON

ZIRCONIA: APPLICATIONS OF ZIRCONIA

Organised by: Engineering Education Technical Division, IEM

SPEAKER:

Ir. Ts. Dr. Alexander Chee Hon Cheong

MODERATOR:

Ir. Assoc. Prof. Dr. Siva Kumar Sivanesan

REGISTRATION FEE :

IEM STUDENT : FOC
IEM MEMBERS: RM15
NON IEM MEMBERS: RM70

7 JUNE 2023, WEDNESDAY

3.00PM - 5.00PM

Follow Us:

myiem_official

MyIEM HQ Official - General

www.myiem.org.my

SYNOPSIS

The effect of adding transition metal oxide (CuO) on the sintering behavior of 3 mol% Y-TZP was systematically investigated. The CuO dopant, ranging from 0.05 wt% to 1 wt%, were attrition milled with the base Y-TZP powders to obtain the CuO-doped Y-TZP. The first phase of the research investigated the effect of conventional single-step sintering (SSS) cycle, performed over the temperature range of 1250 to 1500oC, was carried out in order to understand the influence of CuO on the properties of Y-TZP. The second phase of the work involved the use of pressureless two-step sintering (TSS) cycle to promoted densification without inducing grain coarsening in the CuO-doped Y-TZP and to elucidate the sintering mechanism. The study revealed that for the SSS scheme, the addition of up to 0.2 wt% CuO dopant was most effective in enhancing the densification and mechanical properties of the Y-TZP in particularly at low temperatures below 1350 oC. The phase analysis revealed that the tetragonal phase was disrupted as evident from the monoclinic phase formation as the CuO amounts exceeding 0.2 wt%. In particular, the 1 wt% CuO addition was detrimental and samples exhibited high porosity and low mechanical properties. However, in all cases, the development of the cubic phase was not observed in the present work. The role of CuO has been explained and associated with mechanism involving the reaction with yttria stabilizer forming a transient liquid phase during sintering. The research also demonstrated that the fracture toughness of the Y-TZP was governed by a grain size limit which varied depending on the amount of doping levels. In addition, the Vickers hardness was found to increased linearly with the bulk density. Nevertheless, the study revealed that compared to the undoped Y-TZP, the addition of 0.2 wt% CuO resulted in enhanced hardness and finer grain sizes when sintered at relatively low temperatures. In the TSS cycle, the results confirmed that efficacy of this scheme in aiding densification of CuO-doped Y-TZP without inducing grain coarsening. The beneficial effects of TSS in enhancing the Vickers hardness and fracture toughness of tetragonal zirconia when compared to SSS, without incurring grain growth have been demonstrated. This feature of TSS which allows for the inhibition of grain boundary migration and the activation of grain boundary diffusion at lower dwelling temperature during sintering were responsible for the enhancement of the mechanical properties of tetragonal zirconia.

SPEAKER'S BIODATA

Ir. Ts. Dr. Alexander Chee Hon Cheong
Professional Member (BEM), Chartered Engineer (CEng, MIMechE), Professional Technologist (P.Tech, MBOT), Microsoft Certified Innovation Educator (MIE)

PhD. Mechanical Engineering, 2020
University of Malaya (UM)
Msc. In Design Engineering (Aerospace), 2010
University of Putra Malaysia (UPM)
Bachelor (Hons) of Mechanical Engineering (Material), 2003
University of Tun Hussein Onn Malaysia (UTHM)

Research experties: Material Science, Robotics and Automation, Engineering Education