A small angle neutron scattering study of isolated nanopores in a ceramic

R. Raut Dessai, J.A.E. Desa, D. Sen, S. Mazumder

PII: S0925-8388(14)03031-X
DOI: http://dx.doi.org/10.1016/j.jallcom.2014.11.215
Reference: JALCOM 32892

To appear in: *Journal of Alloys and Compounds*

Received Date: 30 August 2014
Revised Date: 20 November 2014
Accepted Date: 23 November 2014

Please cite this article as: R. Raut Dessai, J.A.E. Desa, D. Sen, S. Mazumder, A small angle neutron scattering study of isolated nanopores in a ceramic, *Journal of Alloys and Compounds* (2014), doi: http://dx.doi.org/10.1016/j.jallcom.2014.11.215

A small angle neutron scattering study of isolated nanopores in a ceramic

R. Raut Dessai[a], J.A.E. Desa[a*], D. Sen[b] and S. Mazumder[b]

[a]*Department of Physics, Goa University, Taleigao Plateau, Goa 403206, India.*
[b]*Solid State Physics Division, Bhabha Atomic Research Centre, Trombay, Mumbai 400 085, India.*

**Corresponding Author Tel.:+91-832-6519075; Fax: +91-832-2452889*
Email:erwindesa@gmail.com

Abstract

The isolated pores in a silica ceramic sintered at 1073 K and 1273 K have been studied by small angle neutron scattering using the technique of scattering contrast factor variation. A mixture of H_2O and D_2O which matched the scattering length density of the ceramic matrix was introduced in to the pores of the sample. The connected pores were thus contrast matched and hence the measured intensity was solely due to the presence of the isolated pores having no contrast matched liquid inside. Analysis of the data yielded a widely separated bi-modal distribution (with modes at ~ 170 nm and 35 nm) of nanopores in the compacts. A qualitative model for the sintering in this ceramic is proposed where densification of the matrix occurs by annihilation of smaller pores. However, this is associated with enhancement in the number of larger pores through pore coalescence. In this description the connected pores both - macro and nano - increase in number - simultaneous with a decrease in numbers of isolated pores.

Key words: ceramics, sintering, isolated pores, porosity, small angle neutron scattering

1. Introduction

Isolated pores are those pores which are sealed within the grain structure of a solid. The network of pores which is open to the surface and through which a liquid can flow in and out of the porous solid is referred to as a connected pore network. Well defined porosity, pore morphology, pore size distribution and connectivity can affect the material properties for