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

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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 H₂O and D₂O 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

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