CHARACTERIZATION OF 20 GDC ELECTROLYTE BY BET, TEM.

Koteswararao P, Centre for Nano Science and Technology, Jawaharlal Nehru Technological University, Hyderabad,

M Buchi Suresh, Center for Ceramic Processing, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad, AP, India

B N Wani, Bhabha Atomic Research Centre, Trombay, Mumbai

P V Bhaskara Rao, Physics Department, St. Mary's Engineering College, Deshmukhi, R.R (DT)

Abstract: *In this study, gadolinium doped ceria electrolytes for solid oxide fuel cell application were developed based on the physiochemical properties of the powders. 20GDC nano powder with average particle size of 30nm and purity >99.99% was procured from Cottor International, Mumbai, India. The specific surface area of pure GDC was determined using Quantachrom Nova 1000e surface area analyzer in the presence of nitrogen gas. Average particle size of 20GDC powder has been calculated by using Transition Electron Microscope (TEM) and it is found to be around 30nm.*

Key words: Tem, Gdc, Sofc, Ceria

1. INTRODUCTION

Fuel cells have received great attention as environmentally friendly and efficient to generate the electric power for both stationary and mobile applications [1]. Among the various fuel cells investigated, solid oxide fuel cells (SOFCs) have the following advantages [1–3] namely durability of the solid (rather than liquid) electrolyte materials, high energy conversion efficiency (up to 60–80%), wide variety of fuels (including hydrocarbons and oxygenates) , non-noble metal electrode and no threat from CO poisoning. Yttria stabilized zirconia (YSZ) materials are mainly used as an electrolyte due to their stability and high ionic conductivity at high temperature 1000 °C. But YSZ shows low ionic conductivity at lower temperature [4, 5]. Ceria doped with heterovalent cations, such as alkaline earth and rare earth ions, have been considered one of the most promising electrolyte materials for intermediate temperature solid oxide fuel cells (IT-SOFCs). These materials demonstrate much higher ionic conductivity at relatively low temperatures in comparison to that of YSZ. Among the various dopants studied, Gd^{3+} and Sm^{3+} singly doped ceria (abbreviated as CGO and CSO) have been reported to have the highest conductivity and to be relatively stable in the reducing environment [6-8]. This paper mainly discusses the structural characterizations of 20 % Gd doped ceria ($Ce_{0.8}Gd_{0.2}0_{1.9}$ hereafter termed as 20 GDC) such as BET, TEM analysis.

2. EXPERIMENTAL

Purity with more than 99% of $Ce_{0.8}Gd_{0.2}0_{1.9}$ (20 GDC) powder was purchased from Cottor International (Mumbai) and the powder was used to carry out the experimental studies. BET measurements were carried out for finding the surface area of the nano powder, and Particle size measured by using TEM in agreement with XRD crystallite size.

3. BET ANALYSIS

The specific surface area of pure GDC was determined using Quantachrom Nova 1000e surface area analyzer in the presence of nitrogen gas. Before adsorption/desorption isotherm, sample was after degassed at 300 °C for 3 hours.

	GDC 20
Surface Area	$4.858 m^2/g$
Pore Volume	0.006cc/g
Pore radius	25.894 A
Total pore volume	$7.504*10^{-03}$ cc/g

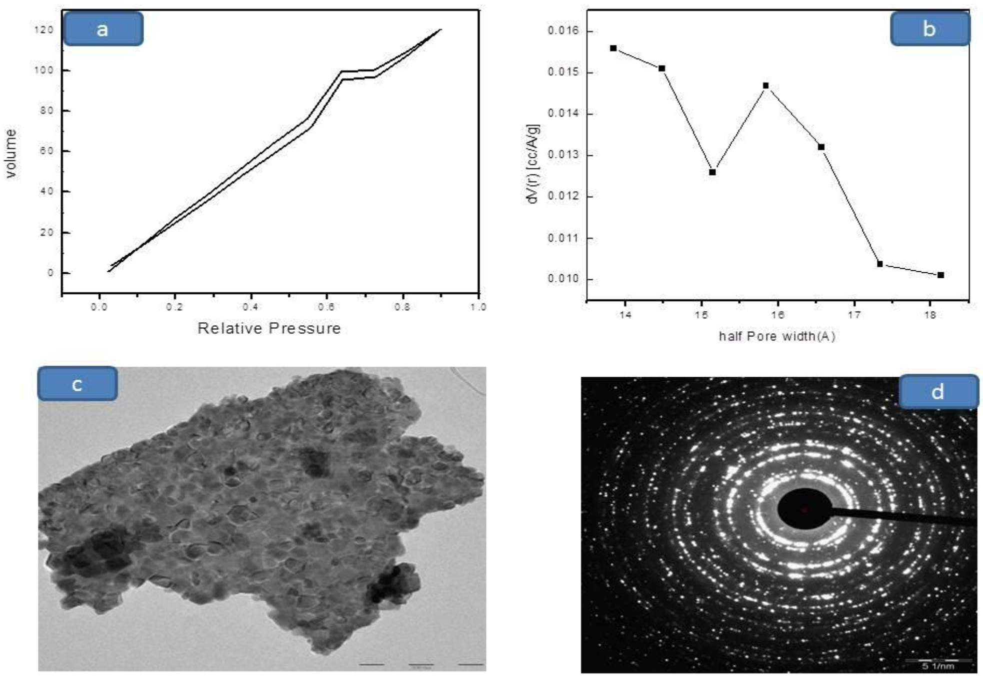

Fig 1.a) Fig shows adsorption/desorption isotherm of GDC20. Below 0.3 pressures Monolayer formation of adsorption on the material and beyond 0.7 multilayer formations is due to desorption of Nitrogen gas.

Fig 1b) shows the variation of pore volume with respect to half pore width. Pore volume is maximum at 14 half pore width .After increasing pore width, pore volume decreased again and increased up-to 16.Later on the pore volume decreased by increasing half Pore width due to Micro pore Capillary effect.

Fig 1c) shows uniform shaped nano crystals with uniform size and compacting each other due to temperature effect on Particles. The mean diameter of the individual nanoparticles measured to be -28nm. 20 GDC powder was examined with High Magnification Transition Electron microscopy (TEM, JEOL 2010, Japhan) .

Fig:1 d) Lattice fringes visible in TEM image displayed indicate the high crystallinity of these particles. Selected area electron diffraction shown in the above figure agrees with structure of XRD results (Fluorite structure Ce fm 3m with lattice constant 5.423A)

ACKNOWLEDGMENT

The Author is grateful to the “Pravin Jadav’’ Research scholor Shivaji University and for providing BET facility for my samples" and is also thankful to “UGC-DAE CSR Kalpakam Centre for providing TEM facility for my samples".

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