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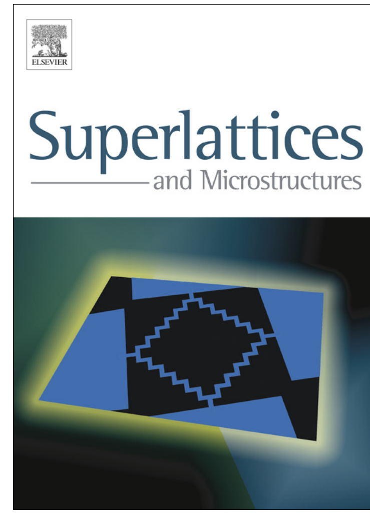

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Effects of temperature and electric field on the transport mechanisms in the porous microstructure

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Abstract

The electrical characterizations of nanoporous zeolite and transport mechanisms were studied for the first time in a wide operating temperature range (28-800 K) and electric field strength (60-200 kV/cm) at room temperature. The influence of temperature, electric field and cell types on the dc conductivity was described. The resistivity decreased from 2.34×10^{10} to 2.17×10^{8} Ωcm whiles the temperature increased from 28 to 800 K which is associated with the ionic mobility. The existence of water in the channels and pores is the decisive parameter in the ionic transport and it depends strongly on the electric field. When a high voltage was applied to gas discharge gap and porous structure, ionization phenomena increased. In this stage, electronic conduction also contributed to zeolite dc conduction. Therefore, the ionic and electronic transport mechanisms and their interactions are essential in enhancing applications in microdischarge devices with nanoporous zeolite cathodes.

Keywords: Aluminosilicate materials; dc conductivity; Thermo-electric properties; Nanoporous zeolite cathode; Transport mechanisms; Electric field strength.

1. Introduction

Nanoporous materials contribute to different significant technological processes from catalysis and separation to capacitive electrical storage [1]. Aluminosilicate zeolites have three-dimensional framework structures. The zeolite structure is built from TO_4 (T = Si, Al) tetrahedra which are linked together to form a three-dimensional framework of interconnecting pore and channel structures. It is known that zeolite is predominantly in the ionic conductivity [2,3]. Charge is carried by means of the motion of mobile charge balancing ions in the anion framework. Hydrated zeolites are also known as proton conductors and hydroxyl ion conductors [4]. It is usually presumed that zeolites do not act as electronic conductors [5].

Dielectric materials such as zeolites have the ability to store energy when an external electric field is applied [6]. Using of mixed conductors is in energy applications (electrical energy storage) in ion-exchange membrane technologies and catalysis where an electrically conducting framework is necessary [7]. Studying the electronic and ionic conduction