PROTON CONDUCTION IN CONDENSED PHASE

A PROJECT REPORT PRESENTED

by

THARMALINGAM SIVARUPAN

to the

board of Study in Physics

of the

POSTGRADUATE INSTITUTE OF SCIENCE

in partial fulfillment of the requirement
for the award of the degree of

MASTER OF SCIENCE IN PHYSICS OF MATERIALS

of the

UNIVERSITY OF PERADENIYA
SRI LANKA
2006

ABSTRACT

Proton conducting solid materials have attracted considerable interest, because of their great promise in applications such as fuel cells, humidity sensors, batteries etc.. However, most proton conductors decompose at high temperatures, so that their practical applications have been very limited, so far. As global petroleum stock is expected to finish very rapidly, we need to find an alternative and environmentally friendly energy source, or we should enhance the efficiency of the currently available environmentally friendly energy sources, such as fuel cell, solar cell, etc. Therefore, it is important to find a material with high proton conductivity at a vast range of temperature, and it must be chemically, thermally, and mechanically resistant.

The research was mainly focused on proton conductivity in compacted Titania nano particles, in which mobile protons were created by adding suitable substances, and to understand the factors affecting the proton conductivity in compacted nano particles. In this way, DC polarization tests were done to the materials (TiO_2 and ZnO), in which mobile protons were created. Here salicylic acid ($C_6H_4(OH).COOH$) and water (H_2O) were used to create mobile protons in the samples.

Whenever DC polarization test is done, current should decrease with time. However, in the case of compacted Titania nano particles, in which mobile protons were created, a different behaviour was observed. In our experiment for TiO_2, in which mobile protons were created, the change of current with time initially showed a decrease, and then a peak, which was followed by another decline. Therefore, it can be concluded that the proton conductivity in this material depends on the amount of mobile protons and some other ions.

August 2006