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Preparation and Humidity-Sensitive Characteristics of Fluorapatite Compounds

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Fluorapatites, $Ca_{10}(PO_4)_6F_2$, substituted with alkaline and alkali earth metal ions were prepared and their humidity-sensing characteristics were investigated. Partial substitution was done in the synthesizing process by using carbonates of Li, Na, K, Sr and Ba instead of $CaCO_3$ only. Substitutions were such that $Ca_{10-x}M_x(PO_4)_6F_{2-x}$ (M = Li, Na and K) and $Ca_{10-x}M'_x(PO_4)_6F_2$ (M′ = Sr and Ba). For Na and K, the impedance decreased as x increased. The hysteresis characteristics of these compounds are fairly good compared with those of other ceramic humidity sensors.

1. Introduction

Recently, many kinds of humidity sensors based on ceramics have been developed and investigated. For most of them, the electrical resistance has a tendency to be increased by irreversible adsorption of the OH radical especially in the low relative humidity region, which increases with exposure to humidity. Therefore, some sensors are periodically heated to desorb the OH radical. It is important for us to improve the irreversible adsorption.

For this purpose, hydroxyapatite, $Ca_{10}(PO_4)_6(OH)_2$ which contains OH radicals in its chemical formula, has already been reported by Komine et al.[1] and Miyazaki et al.[2] In this paper, we report fluorapatite which has F radicals in place of OH radicals for the following reasons. The electronegativity of F radicals is slightly larger than that of OH radicals. Furthermore, the crystal structure of fluorapatite (hexagonal: $P6_3/m$) is more stable than that of hydroxyapatite (pseudohexagonal: $P2_1/b$).

The Ca and P sites can be substituted by many metal ions. Thus, the authors