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NO_2 and CO_2 Sensing Properties of LISICON-Based Sensor Operative at Room Temperature

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Four types of sensor were fabricated by combining solid-state electrolyte (LISICON or NASICON) disks with sensing electrode materials, such as Au, indium tin oxide (ITO), and auxiliary phase (nitrate or carbonate). Their NO_2 and CO_2 sensing properties were examined under 30% relative humidity (RH) in the temperature range of 30 to 100°C. When the NO_2 sensor was operated in the range of 2 to 7 ppm NO_2 at 30°C, the LISICON sensor attached with ITO-$NaNO_2$ had the highest sensitivity to NO_2 and the electromotive force (EMF) change was 41.4 mV. At 30°C under 30% RH, the EMF values of the LISICON sensor attached with ITO-$NaNO_2$ were proportional to the logarithm of NO_2 concentration. Also, when the CO_2 sensor was operated in the range of 250 to 2,500 ppm CO_2 at 30°C, the LISICON sensor attached with ITO-Li_2CO_3-$BaCO_3$ had the highest sensitivity to CO_2 and the EMF change was 20.0 mV. At 30°C under 30% RH, the EMF values of the LISICON sensor attached with ITO-Li_2CO_3-$BaCO_3$ were correlated linearly with the logarithm of CO_2 concentration. Subsequently, to examine gas selectivity, the NO_2 selectivity of the sensor attached with ITO-$NaNO_2$ and the CO_2 selectivity of the sensor attached with ITO-Li_2CO_3-$BaCO_3$ were evaluated at 30°C under 30% RH. As a result, it was found that the LISICON and NASICON sensors attached with ITO-$NaNO_2$ were fluctuated by the change in CO_2 concentration. On the other hand, although the NASICON sensor attached with ITO-$Li_{22}CO_3$-$BaCO_3$ was affected by the NO_2 concentration change, the LISICON sensor attached with ITO-Li_2CO_3-$BaCO_3$ showed a high CO_2 selectivity. From thermodynamic calculations, it was considered that the chemical instability of NASICON and $NaNO_2$ under CO_2 led to the degradation of NO_2 gas selectivity in the ITO-$NaNO_2$-attached sensor, whereas that of NASICON under NO_2 caused the degradation of CO_2 gas selectivity in the ITO-Li_2CO_3-$BaCO_3$-attached sensor.

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