Supporting Information

Effects of Varying the Preparation Conditions on the Dielectric Constant of Mixed Metal Oxide Films Derived from Layered Double Hydroxide Precursor Films

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Experimental Section

Measurement of the dielectric constant:

The dielectric constant of the film was measured by using an Agilent 4294A Precision Impedance Analyzer at a frequency of 1 MHz as reported elsewhere. The prepared samples were all dried overnight at 100 °C followed by cooling in a desiccator prior to the capacitance measurements, to minimize water adsorption. A metal–insulator–metal (MIM) capacitor structure was fabricated. The sample was first cut to a size of 1×1 cm. The reverse sides of the coated aluminum substrate were scratched. The top (film) side was painted with silver paste in order to improve the contact between the sample and the measurement electrodes. The silver paste was dried in the oven with temperature at about 100 °C. The dielectric constant of the samples was calculated by the formula of a parallel plate capacitor as \( k = \frac{c}{k_0A} \), where \( c \) is the capacitance of the MIM element, \( k_0 \) is the vacuum dielectric constant, \( d \) is the thickness of the samples and \( A \) is the area of the film. The capacitance was measured at several points in the sample, and the \( k \)-values reported here are average values.
Figure S1. The FTIR spectra of the powders scraped from the LDH precursor film (a) and
the calcined MMO film (b).

As Figure S1a illustrates, the FTIR spectrum of the powder scraped from the LDH
precursor film in the region 400–4000 cm\(^{-1}\) shows the typical absorption peaks of LDHs.
A strong and broad absorption band centered around 3443 cm\(^{-1}\) can be identified as the
hydroxyl stretching band \(\nu\) (OH\(_{\text{str}}\)), arising from metal hydroxyl groups and
hydrogen-bonded interlayer water molecules. Another absorption band resulting from the
hydroxyl deformation mode of water, \(\delta\) (H\(_2\)O), is recorded at around 1624 cm\(^{-1}\). A sharp
absorption band at 1360 cm\(^{-1}\) is attributed to the \(\nu_3\) (asymmetric stretching) mode of
CO\(_3^{2-}\) ions in the interlayer. The blueshift of this band compared to that observed for the
free carbonate anion (ca. 1415 cm\(^{-1}\) ) is attributed to the restrictions imposed by the
interlayer gallery. The other bands observed in the range 500–800 cm\(^{-1}\) are mainly due to
M–O, M–O–M, and O–M–O lattice vibrations. For the spectrum of the MMO powder
shown in Figure S1b, the absorption band at 1360 cm$^{-1}$ is absent, which demonstrates that CO$_3^{2-}$ ions decompose on heating. The intensity of the bands at about 3415 cm$^{-1}$ and 1618 cm$^{-1}$ also decreased by dehydroxylation. The bands below 1000 cm$^{-1}$ are the vibration modes for Mg–O and Al–O in the mixed oxide formed. (Yanga, W.; Kima, Y.; Liub, P. K. T.; Sahimia, M.; Tsotsisa, T. T. A study by in situ techniques of the thermal evolution of the structure of a Mg-Al-CO$_3$ layered double hydroxide. Chem. Eng. Sci. 2002, 57, 2945.)
Figure S2. SEM image of the MMO film on aluminum after testing for adhesion