S1. In order to investigate the conformity in the physical film thickness and dielectric properties of the films on the 3-D structured capacitors, contact hole type MIM capacitors composed of Ru/ATO (R_{pc} of 1/60)/Ru layers were fabricated with different hole diameters and distances between the holes. The detailed fabrication method was described elsewhere.\textsuperscript{[18]}

![Image of graph showing variations in calculated and measured capacitance with distance and hole size.]

Figure S1. The variations in the calculated capacitance and measured capacitance of the 3D MIM capacitor arrays composed of Ru/ATO (R_{pc} of 1/60)/Ru layers as a function of the distance between the holes for the two hole diameters.
Figure S1 shows the variations in the calculated capacitance and measured capacitance of the 3D MIM capacitor arrays as a function of the distance between the holes for the two hole diameters. The total surface area can be calculated from the hole diameter, depth, and distance between the holes measured by SEM. The calculated capacitance can be obtained from the surface area and the capacitance per unit area. It can be seen that the calculated and measured capacitances coincide very well with each other in the entire hole-to-hole distance region (Fig. S1). This suggests that the conformity in the dielectric properties as well as the physical and compositional step coverage of the ATO films was ensured.