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Strong electron correlation enhancement to capacitance via frustrated phase separation[1] JAMES FREERICKS, SIMON HALE, Department of Physics, Georgetown University — Recent experiments on strongly correlated capacitors from Mannhart's group have shown that the capacitance can be enhanced by about 50% over the geometric capacitance when the metallic leads are gated to be nearly depleted of electrons. More recently, direct measurements of the electron compressibility in those leads show that they become phase separated in this regime. It has long been known that proximity to phase separation, or equivalently negative electron compressibility, should lead to an enhancement of capacitance. In this work, we show that this phenomenon is quite general. By employing a microscopic model of a strongly correlated capacitor composed of multilayers of electronic leads and a Mott insulating dielectric, we show that by tuning the barrier to lie in the regime where it is phase separated in the bulk, it exhibits a type of frustrated phase separation in the multilayer, which gives rise to an enhancement in the capacitance with capacitance curves versus gate voltage resembling quite close to those of experiment. In the calculations, the enhancement effect is lower (on the order of 10%), and the mechanism is different, because here the phase separation is in the dielectric instead of the metallic plates. Nevertheless, this behavior seems to be ubiquitous.

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