Effect of Interfacial Adhesion on the Critical Breakdown Field Strength of Soft Dielectric Thin Films: An Experimental Study (Postprint)

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Date: 2024-02-07T00:00:00+00:00

Abstract

Soft dielectric films are widely employed in electrical and electronic systems owing to their low modulus, capability for large deformation, and high adaptability. However, due to their relatively low dielectric constant, they typically must operate under high electric field conditions. In such high-field environments, soft dielectric films are susceptible to instability and electrical breakdown, which constrains their application scope and reliability. This study investigates the stability of these devices under two scenarios: electrodes with and without constraint on the soft dielectric film. First, we quantitatively characterize the evolution of instability morphologies during voltage loading and unloading when the electrode is unconstrained. Second, we examine the suppression of electromechanical instability in the film by soft electrodes such as lithium chloride hydrogels, and demonstrate that chemical bonding can enhance the constraint of hydrogel electrodes on the dielectric film, thereby elevating its critical breakdown field strength.

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