The effects of conductive materials inside a dielectric elastomer actuator

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Among many types of electroactive polymers, dielectric elastomers have been studied as artificial muscles in many applications due to their large deformation. The main issue on dielectric elastomer is how to increase an actuation strain. As the applied voltage increases, the actuation strain increases but the electromechanical instability may occur. In order to reduce the instabilities under higher voltage, several ideas such as applying prestrain or using interpenetrating polymer network material have been investigated. However, there have been only few studies about increasing actuation strain without increasing the voltage. To increase actuation strain under the same voltage, we put ionic liquids as conductive materials inside the dielectric elastomer. Tube actuator models were simulated to investigate the effect of the ionic liquid inside the dielectric elastomer on the maximum actuation strain with various dielectric constants and geometries. We found that the conductive material inside the dielectric elastomer enlarges the actuation strain under the same voltage. This study may help to design a more efficient dielectric elastomer actuator which can be operated with a lower applied voltage.