

Dielectric Adaptive Optical Gels

R. Eisenschmid¹

¹OPTIMA pharma GmbH, Schwäbisch Hall, Germany

Abstract

Adaptive Optics is common sense, since many people use digital cameras with electromechanical iris actors on elastic autofocus lenses.

This project tries to create a COMSOL Multiphysics based mathematical model of adaptive optics with electrostatically induced deformation of dielectric gels. Upper and lower sides of a lens (dielectric conductive gel) are coated by transparent conductive films, i.e. TCO (transparent conductive oxides). These "film electrodes" could have any shape, like concentric rings or an array of hexagonal patches, and controlled by microcontrollers. So different electrical charges can be placed on the surface, inducing arbitrary electric homogeneous or heterogeneous fields in the gel. The electric fields cause deformations in the lens, while any aspherical optics are imaginable.

The COMSOL Model couples electrostatic fields with elastic structure mechanics on elastic materials. Here we used a rotation-symmetric plano-convex lens as primary shape. The film electrodes can be considered as concentric rings, while voltage and surface charge only depend on the radius of the lens. Example electric potential with deformation of this lens (Figure 1) and deformation of this lens, caused by a different electric field (Figure 2).

COMSOL Multiphysics is a convenient tool modeling this kind of coupled physics. This approach also can be used for design of adaptive reflectors, i.e. for telescopes.

Reference

C. Baohong et. al. . "Highly Stretchable and Transparent Ionogels as Nonvolatile Conductors for Dielectric Elastomer Transducers." ACS Applied Materials & Interfaces 6 (10) (May 28, 2014): 7840–7845.

R. Pelrine et.al., High-field deformation of elastomeric dielectrics for actuators, Seiki Chiba SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025, USA, (1999)

Figures used in the abstract

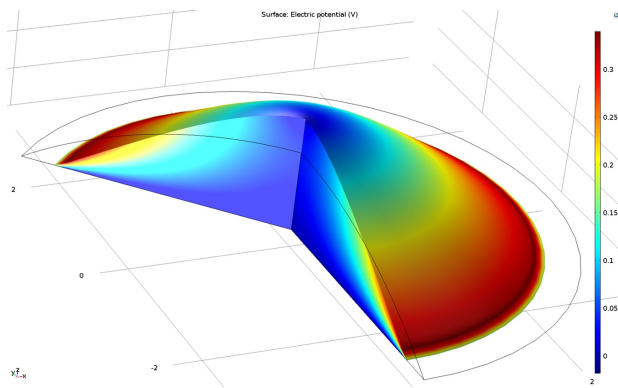


Figure 1: electric field induces deformation

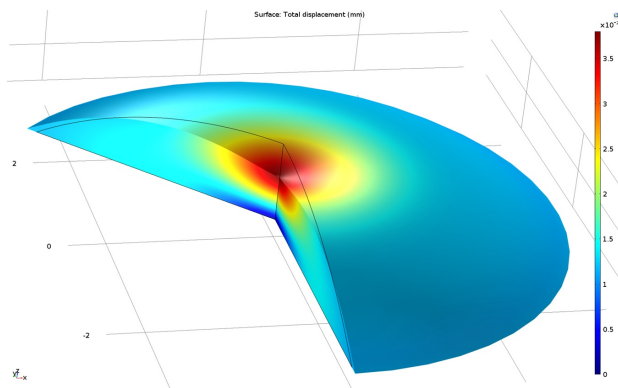


Figure 2: deformation on a different electric field



Figure 3



Figure 4