

High permittivity thin elastomer films for low voltage actuatorsD. M. Opris, Y. Sheima²¹Empa, ²University of Fribourg

Stretchable capacitors are capable of converting electrical energy into mechanical work, however, high driving voltages are required. Reducing the thickness and increasing the dielectric permittivity of the dielectric elastomer allows reducing the driving voltage. The dielectric permittivity of an elastomer can be increased by chemical modification with polar groups. Using this approach, we have recently prepared novel polysiloxane based elastomers with a permittivity as high as 18 and excellent mechanical properties.¹ Actuators constructed with them show about 20.5% lateral strain at an electric field as low as 10.8 V/mm. Despite of this progress achieved, it turned out to be challenging to process the material into sufficiently thin films.² To overcome this problem, we modified first a polymethylvinylsiloxane of a high molar mass with 3-mercaptopropionitrile while leaving some vinyl groups unreacted. The resulting polymer was subsequently cross-linked in thin films whereby the vinyl groups were used. This was achieved via a thiol-ene reaction, but because a low volatility multifunctional cross-linker was used, the processing in thin films can be conducted using conventional techniques in any lab equipped with hoods. This allowed us to process films with a thickness below 20 microm. No further attempts were conducted to reduce thickness even more, however, processing films thinner than 5-10 microm is challenging. A lateral actuation of about 7% was measured at 300 V with a 35 microm thick film. Additionally, the actuators were able to self-repair after a breakdown which led to improved device lifetimes and increased reliability.

[1] Simon J. Dünki, Yee S. Ko, Frank A. Nüesch, Dorina M. Opris, *Adv. Funct. Mater.*, **2015**, 25, 2467-2475.

[2] Simon J. Dünki, Frank A. Nüesch, Dorina M. Opris, *J. Mater. Chem. C*, **2016**, 4, 10545-10553.