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Stretchable and hydrophobic electrochromic devices using wrinkled graphene and PEDOT: PSS

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We present an electrochromic device (ECD) fabricated using PEDOT:PSS and graphene as active conductive electrode films and a flexible compliant polyurethane substrate with 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl) imide (EMI-TSFI) additive, as ionic medium. This device with a docile, elastic intermediate substrate along with a transparency controlled PEDOT:PSS film provides a wide color contrast and fast switching rate. We harness wrinkling instability of graphene to achieve a hydrophobic nature without compromising transparency of the ECD. This mechanical self-assembly approach helps in controlling the wavelength of wrinkles generated by inducing measured prestrain conditions and regulating the modulus contrast by selection of underlying materials used, hereby controlling the extent of transparency. The reduction and oxidation switching times for the device were analyzed to be 5.76 s and 5.34 s for a 90% transmittance change at an operating DC voltage of 15 ± 0.1 V. Strain dependent studies show that the performance was robust with the device retaining switching contrasts even at 15% uniaxial strain conditions. Our device also exhibits superior antiwetting properties with an average water contact angle of $110^\circ \pm 2^\circ$ at an induced radial prestrain of 30% in the graphene film. A wide range color contrast, flexibility, and antiwetting nature of the device envision its uses in smart windows, visors, and other wearable equipment where these functionalities are of outmost importance for developing new generation of smart interactive devices.

Biography

Hossein Sojoudi is an Assistant Professor in the Mechanical, Industrial, and Manufacturing Engineering Department at the University of Toledo. Prior to joining UT, he was a Postdoctoral Associate and Lecturer in the Mechanical Engineering Department at the Massachusetts Institute of Technology (MIT) with a joint appointment in the Chemical Engineering Department. Prior to MIT, Hossein was a Postdoctoral Fellow at the Georgia Institute of Technology, where he obtained his PhD as well in Mechanical Engineering with a Minor in Materials Science. He received several awards including the Materials Research Society Best Presentation Award, Prestigious Ann Robinson Clough Grant, and several other awards from MIT.

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