# Analysis of the mechanical stability during tensile testing of conductive polymers and TCO thin films on PET for flexible hybrid electrochromic devices

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**Abstract**

In flexible organic electronic devices the high brittleness and limited mechanical ruggedness of requisite inorganic thin films are a likely source of failure. It is, therefore, important to understand and improve the mechanical limits of these functional layers [1]. In the present study a multiple film cracking in thin film/substrate composite systems was analysed. Specifically, the experimental measurement of multiple cracking of indium tin oxide films (ITO) deposited by reactive magnetron sputtering on polyethylene terephthalate (PET) substrates was investigated. In addition, thin homogeneous and highly transparent films of the conductive polymer poly(3,4-ethylene dioxythiophene) (PEDOT) were prepared by means of spin coating via moderator controlled in-situ chemical oxidative polymerization of EDOT on the ITO coated PET sheets. Such multilayered films may be used as cathodically colouring electrochemical half cells for the assembly of flexible electrochromic devices. The system was subjected to a unidirectional tensile loading. A shear lag model was used to derive the stress distribution in the system, and the film – cracking problem was analysed using the strength criteria. In addition, a numerical computer simulation was performed to simulate the number of cracks, the crack distribution and the film fracture strength using a Weibull statistical analysis. The simulation predicted successfully the crack density and the distribution of fragment lengths during the progress of multiple cracking. The influence of the polymeric top layer on the mechanical properties of the composite systems is discussed.

[1] J. Lewis, *Materials Today* **9** (2006) 38.

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