Deformable display enabled by hybrid transparent conductors

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Deformation displays such as electroluminescent devices or electrochromics devices require the use of stretchable and deformable transparent conducting substrates for the electrodes formation. The conducting electrodes in displays ideally possess the characteristics of superior conductivity and optical transparency under extreme conditions such as folding, stretching, flexing, rolling or crumpling. We report our strategies on the preparation and fabrication of flexible, stretchable transparent conductors for electrochromics and electroluminescent devices.

We have developed a transfer method to prepare transparent conductors with high figure of merit. This effective transfer method improves the interface properties and bonding stability between the conductive constituents and the matrix. The method can be used to transfer various nanostructures as shown in Fig. 1.[1] The composite consisting of cellulose nanofibrils with metallic nanowires is used to fabricate flexible and foldable transparent conductors for the preparation of flexible wearable electrochromics. The resultant transparent conductor electrode improves the interaction with the overlay electrochemical active material, enhances the charge intercalation, distribution and facilitate ionic diffusion in the presence of electrolyte due to the hydrophilic nanopaper, making this an ideal substrate for electrochromic display.

In addition, we show that the stretchable electrochromics device[2] and stretchable electroluminescent[3] devices can also be fabricated using metallic silver nanowires with polydimethylsiloxane matrix, indicating the promising potential of metallic nanowires based transparent conductors for deformable display applications.

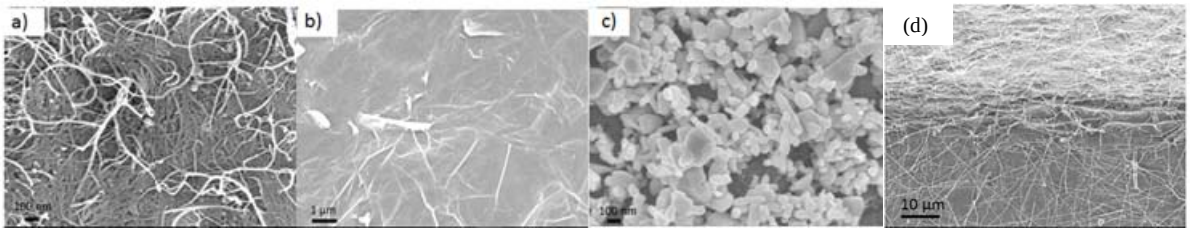

Fig. 1 Various nanostructured materials that have been successfully transferred utilizing the paper-transfer method. a) Single wall CNT; b) Electrochemically exfoliated graphene; c) ZnO nanoparticles (d) Ag nanowires composites[1]

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