PHYSICS COLLOQUIUM
Ultrathin optoelectronic devices: light-weight and extreme flexibility

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Abstract:

Solution-processed semiconductor devices, including perovskite and organic photovoltaics and organic LEDs, are inherently thin-film technologies. Therefore, low-weight and flexibility are natural advantages. However, common substrate materials are over 300 times thicker than the active device materials. Therefore, the mechanical properties of weight and flexibility are entirely determined by the substrate. We present the use of a 1.4 µm PET foil substrate material to demonstrate ultrathin solar cells and LEDs. This allows continuous operation of devices under extreme deformation. We can crumple the films, bend them to radius of under 10 µm, and even stick them to elastomeric tape to form stretchable polymer-based LEDs, and organic, and perovskite solar cells. The mechanical flexibility renders the devices perfectly compatible with elastomeric surfaces, necessary for integration with biological tissues such as human skin. Their weight becomes negligible (only 4 - 5 g/m2), resulting in ultrathin solar cells with the highest specific weight (W/kg) of any photovoltaic technology.1-3