All Low temperature (< 150°C) processed high efficiency and stable flexible perovskite solar cells

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The organic-inorganic hybrid perovskite semiconductors have gained a lot of attention as light absorber layers in thin film photovoltaic cells (PVCs) due to its unique properties such as light absorption, efficient charge carrier transport and low cost synthesis. In last seven years the power conversion efficiency has exceeds 22% on non-flexible substrates, however there is still a huge possibility of improvement to reach near the theoretical limit (31%). To further decrease the cost of perovskite solar cells (PSCs) the fabrication process of perovskite and other layers can be realized by roll-to-roll processes on flexible and light-weight substrates at low temperatures (< 150°C). The other benefits of flexible solar cells are expected to have broad potential applications, including wearable or portable electronics, sun-powered vehicles, etc. The major challenge in realizing a high-performance and stable flexible PSC is to obtain a suitable flexible transparent electrode with mechanically flexible, bending durable, highly conductive and transparent.

Figure 1. (a) J-V characteristics of flexible perovskite solar cells and (b) Maximum power point tracking of best cells under 1 Sun conditions for 55 minutes, the measurements were carried out in ambient conditions.

The present talk will focus on the growth of transparent conducting titanium oxide compact layer on ITO/PEN substrates via roll-to-roll process at relatively low temperature. The triple cation based perovskite devices were fabricated on low temperature grown compact layers. The champion device showed remarkably high efficiency (18%) with Voc of 1.11 V and Jsc 21.7 mA/cm². Maximum power point tracking measurement showed an excellent stability of champion cells under 1 Sun conditions measured for 55 minutes in ambient conditions.