Thermal operating window for PEDOT:PSS films and its related thermoelectric properties

The intrinsically conducting polymer PEDOT:PSS is widely used and has found high recognition due to its excellent electrical conductivity. Its potential applications cover many fields, e.g. thermoelectric energy conversion. Therefore we compared the thermoelectric properties of pristine and DMSO treated PEDOT:PSS films at potential operating temperatures. Here we observed the electrical degradation of the film up to complete failure. Further, the thermal aging of PEDOT:PSS still lacks of understanding. It is pointed out that PEDOT:PSS films show a complex degradation mechanism which includes a morphological and a chemical part. In the range of room temperature and ~160 °C PEDOT:PSS films follow the known exponential degradation which imposes morphological degradation, while at higher temperatures this law is not suitable to match the experimental data. Thus we extended the known exponential equation by an additional exponential degradation term which shows good agreement with the experimental data. The optical absorption spectrum indicates a loss in bipolaron and polaron charge carriers, which reflects the degradation behavior. It can be seen that changes in the optical absorption spectrum after isothermal annealing for more than 50 h occur at temperatures around 120 °C, which marks the transition from morphological to chemical degradation.