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Nanoparticle organic solar cells

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Abstract

Organic solar cells show great potential as a cheap renewable energy technology. In the fabrication process of organic solar cells usually two photo-active components are dissolved in an organic solvent such as chloroform. This solution can be deposited using a variety of printing and coating techniques to obtain a thin film of photo-active material. Deposition processes using organic solvents, however, are undesirable as these pose health and environmental risks, especially in large-scale deposition approaches. In order to mitigate these risks, aqueous based organic semiconductor nanoparticles were prepared using a mini-emulsion technique. The added advantage of using a nanoparticle based approach is the inherent control over domain size. The nano-structure of the photo-active materials is known to have a major impact on the photo-electron conversion efficiency and a domain size of the order of tens of nanometers is found to be optimal. In order to induce a favourable nano-structure, thermal treatments were employed. X-ray photo-electron spectroscopy (XPS) depth profiling measurements were used to determine the chemical composition throughout the organic solar cell. The results provided insight into what drives molecular diffusion of the photo-active constituents and they elucidated the effect of the nano-structure on device performance. Finally, the XPS measurements were used to identify an approach to easily increase device performance while mitigating the health, safety and environmental risks associated with organic solvents.

Biography

Krishna Feron obtained his BSc in Applied Physics (Cum Laude) at Twente University in the Netherlands and has completed his PhD at the age of 25 from the University of Newcastle in Australia. Subsequently he received a postdoctoral fellowship from the Australian Renewable Energy Agency to conduct research into the energy losses in organic cells. He has a joint appointment with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Centre for Organic Electronics at the University of Newcastle. He published several papers in the field of organic solar cells, including an invited review.