Fullerene-containing networks via light induced crosslinking

During the last years, fullerenes have been widely studied in the field of optoelectronic materials due to their interesting electrical properties. Fullerene, also known as Buckminster fullerene, is a pure carbon molecule composed of 60 atoms of carbon with a shape similar to a soccer ball, which was discovered in 1985 by researchers from the University of Sussex and Rice University, and it was named in honor of the American architect, Richard Buckminster Fuller. One of the most appealing features of fullerene is its ability to act as electron acceptor. Polymer-fullerene bulk heterojuntion (BHJ) solar cells are one example of devices in which fullerenes play an important role. BHJ solar cells consist of a blend of a donor polymer, typically P3HT, and fullerene. One of the major challenges of these fullerene-containing solar cells is their stability, since fullerene nano-domains tend to aggregate causing performance losses. In order to overcome this problem, the use of crosslinkers containing groups which can react with fullerenes and avoid fullerene aggregation, have been recently explored.

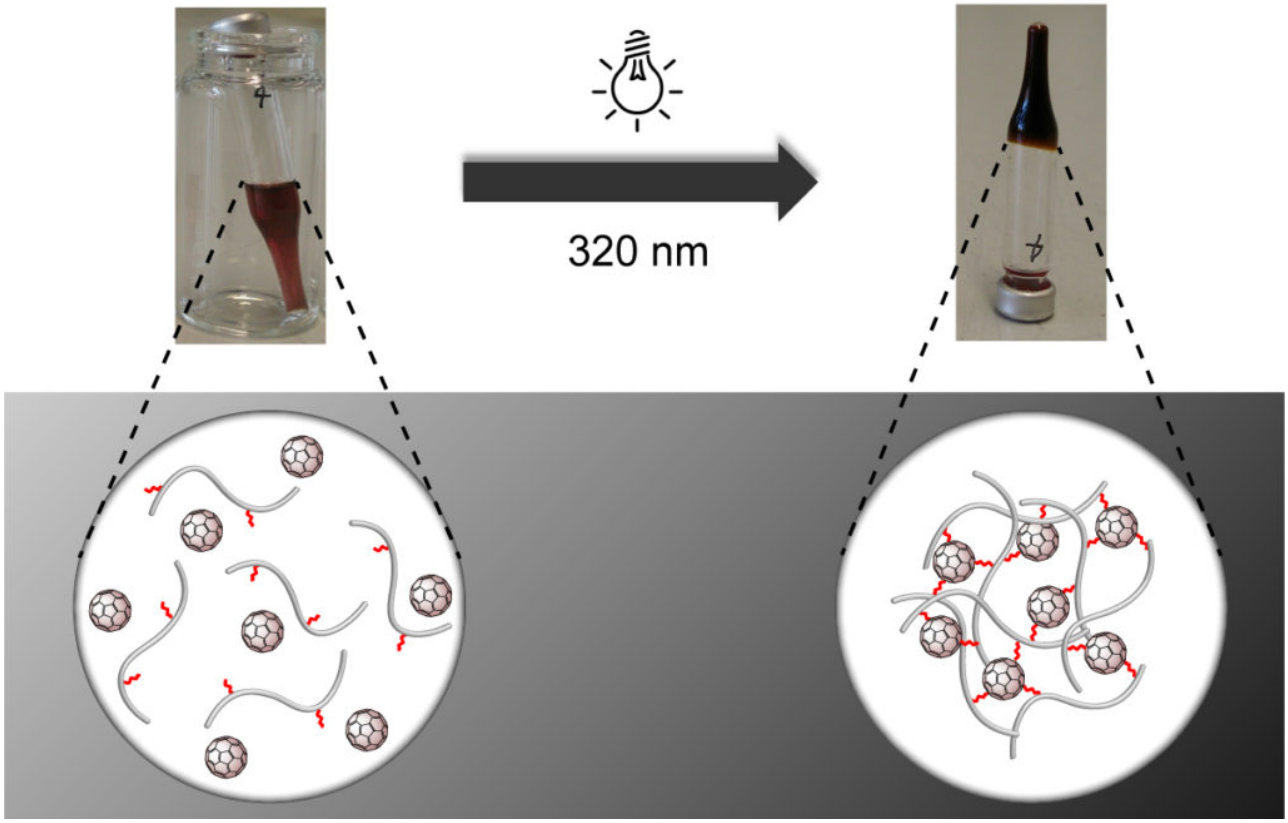

Fig. 1. Scheme for the preparation of fullerene-containing networks.

In our recent study, we report a novel methodology for the fabrication of hybrid fullerene-containing

networks via a light-induced reaction based on nitrile-imine chemistry (Fig. 1). Polymers containing tetrazole moieties as pendant groups were employed as light active materials for the crosslinking with fullerenes (Fig. 2). Upon irradiation, tetrazoles can be activated and a highly reactive nitrile imine intermediate is generated, which undergoes a 1,3-cycloaddition reaction with a range of activated and non-activated double bonds, including those present in fullerenes as we have also recently demonstrated. The network formation was carried out via UV irradiation (320 nm) of a mixture of the tetrazole-containing polymer and fullerene in solution. The fabricated networks were carefully characterized via different analytical methods, such as elemental analysis (EA), fourier transformation infrared spectroscopy (FTIR) and thermogravimetry (TGA). It was demonstrated that – on average – two tetrazoles are able to react with each fullerene forming a stable network.

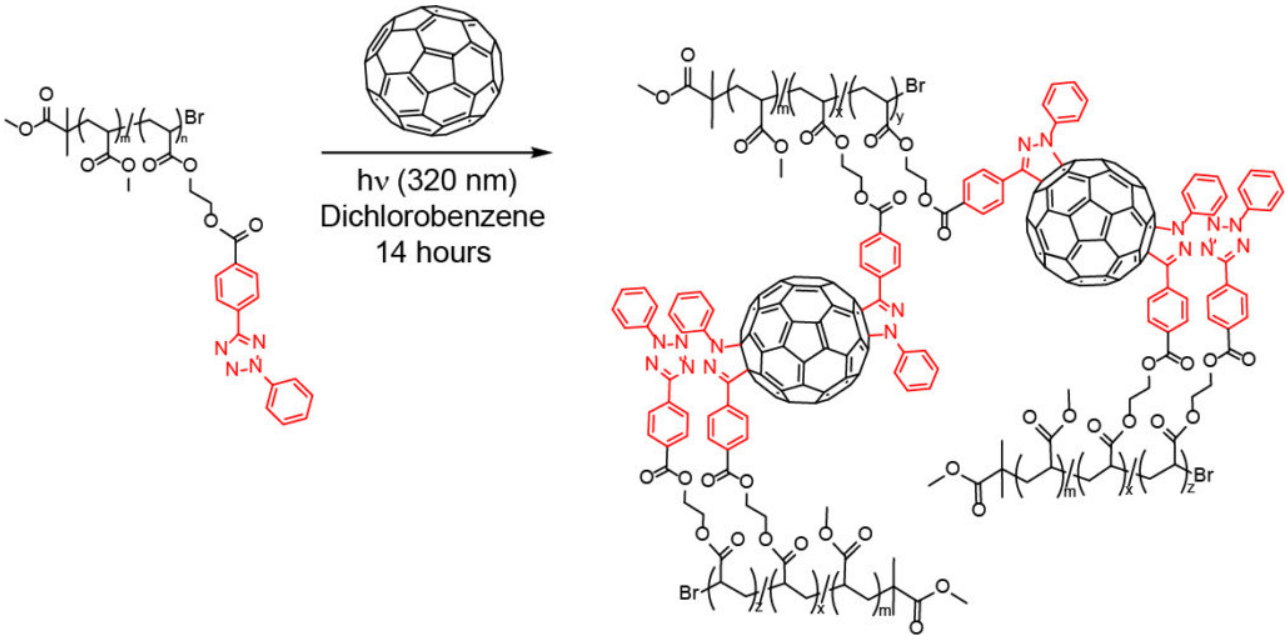

Fig. 2. Synthetic strategy for the preparation fullerene networks via NITEC.

In summary, the preparation of fullerene-containing networks based on tetrazole chemistry has been introduced. We expect that this technology will open new possibilities in the fabrication of new and efficient electronic devices, such as BHJ solar cells, where fullerene morphological stability needs to be improved.

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