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Investigation of the Structure of Organic Solar Cells for Space Application and Degradation Due to Mechanical Stress

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Organic solar cells (OSCs) are emerging as a promising candidate for space application because of their high gravimetric power density and flexible nature, which would save fuel and space in a rocket flight.
However, several challenges must be addressed for OSCs to fulfil their potential in space. Currently, the main problem is the reduction of the degradation due to the harsh conditions during the space flight.
Following a previous project which deployed OSCs in space on a suborbital rocket, our group aims to further investigate the degradation of OSCs in the space environment by reproducing the conditions separately. This work will focus primarily on degradation due to intense mechanical stress. OSCs are exposed to accelerations up to 20 g and strong vibrations during rocket launch and re-entry. This will be simulated with a shaker stress test followed by an investigation of the changed properties of the cell.
The examined OSCs consist of a BTP-4F and PTQ-2F bulk hetero junction, a zinc oxide hole blocking layer, a molybdenum oxide electron blocking layer, a silver anode and an ITO cathode. They are fabricated on glass and flexible PET substrates.
Another topic of this work is to better understand the effects of annealing BTP-4F and PTQ-2F. This leads to a tuning of the bandgap and the absorption spectrum.
As research continues to address material properties and degradation, OSCs have the potential to become a vital energy source for future space exploration missions.

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