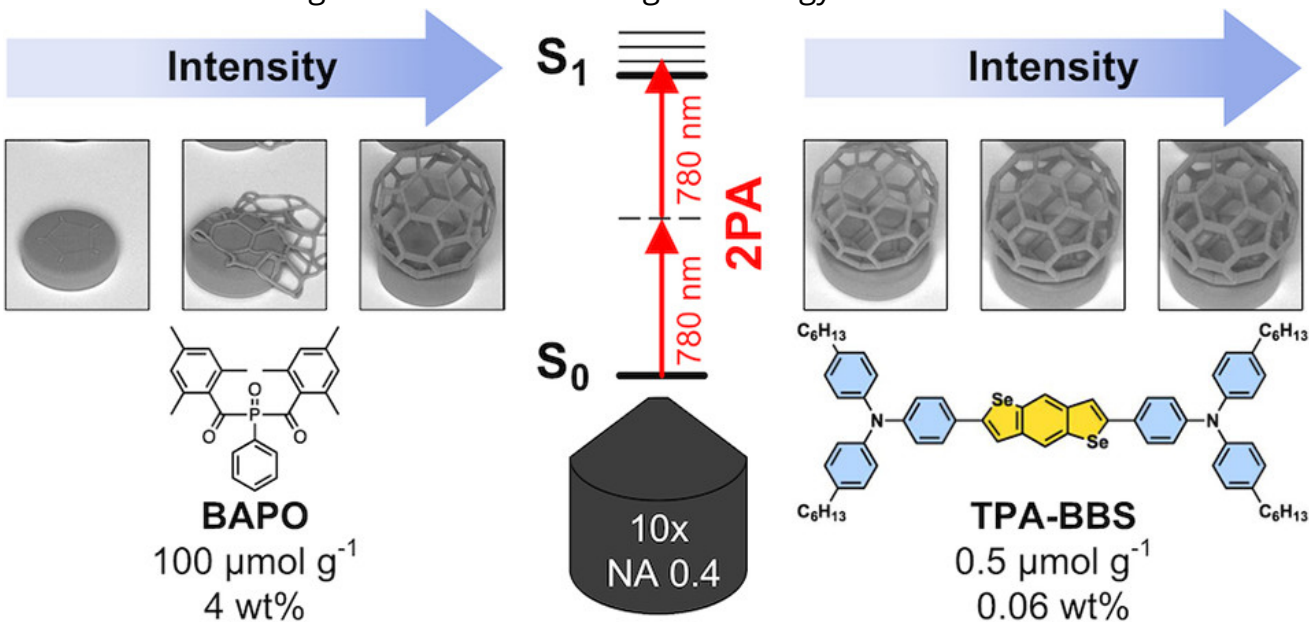
Overview

Two-photon polymerization (2PP) is a powerful high-resolution 3D printing technology that fabricates complex parts from submicron volumetric units called voxels. As voxels are scanned in a line-by-line fashion, print time scales with volume. Faster printing can be achieved by increasing the rate of volume processed per time. This is made possible by recent technological advances such as *Adaptive Resolution*, where the voxel size is dynamically adjusted to the local resolution requirements.
In addition to advances in hardware, recent material developments have been crucial for the transition of 2PP to industrial use.
We report on the design and application of a series of symmetrically substituted chalcogenophenes as potential two-photon absorption (2PA) photoinitiators (PIs). In a detailed photophysical analysis we identified a strong influence of Se on the 2PA cross section, rendering these molecules promising new 2PA PIs. Threshold tests proved the efficiency and spectral versatility of Se-containing compounds. A comparison with commercial PIs **Irg369** and **BAPO** as well as sensitizer **ITX** showed that the new molecule **TPA-BBS** outperforms the UV-PIs by far both in terms of reactivity as well as print quality, demonstrating the great potential of these PIs for 2PP systems where only low laser power is available or high power is required due to an enlarged voxel size.
Using a related PI we could recently show that 2PP directly generates highly crosslinked polymer parts requiring no further post-curing. Here, various macroscopic test samples were produced by 2PP and tested using common or standardized material tests. Compared to UV-cured reference samples, the 2PP specimens were highly cured directly after printing. In addition to mechanical characterization, thermo-mechanical, and fracture properties of 2PP specimens as well as the effects of post processing and aging were investigated. The results of this work are of great importance for the design and construction of complex micro-parts in applications such as microfluidics or medical devices using 2PP as manufacturing technology.



TPA-BBS is a highly efficient 2PP PI outperforming UV-PIs both in terms of reactivity as well as print quality.