MASTERBOND®
CASE STUDY

UV18S: Utilized to seal a static mixer for X-ray studies of biological macromolecules

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Overview of UV18S

Master Bond UV18S is a single-component UV-curable system for bonding applications and shows excellent chemical resistance as well as toughness. It cures within 20–30 seconds under UV irradiation at wavelengths in the range of 320–365 nm. UV18S bonds well to various substrates such as plastics and glass, including the glass capillaries used to develop a sample mixer for X-ray studies of biomolecules.

Application

Small-angle X-ray scattering (SAXS) provides valuable information about large biomolecules such as proteins and can help identify drug targets. However, many molecules of interest cannot be produced in quantities sufficient for certain analytical techniques, so small-scale analytical techniques are necessary. In a Ph.D. thesis at Cornell University, a researcher developed three different sample-saving analytical techniques for biomolecules, one of which was specifically designed for the SAXS analysis of reactions occurring between large biomolecules such as proteins. In this technique, they developed a scaled-down version of an industrial static mixer to perform time-resolved SAXS experiments to investigate the reaction kinetics and then bonded and sealed the device with Master Bond UV18S.

Key Parameters and Requirements

As shown in ***Figure 1***, two capillaries on the left house two reactant-containing liquids that are fed into a mixing insert that contains static mixing elements that ensure good mixing between the two feed liquids without the need for additional agitation. The insert was housed in an observation capillary with low background scattering to obtain a high signal-to-noise ratio. The supply lines were inserted into the mixing insert, and then UV18S was wicked into the ports surrounding the supply lines using a piece of glass. Once UV18S reached the desired location, it was rapidly cured using a 365 nm LED light source. Because the insert and capillaries absorbed significant amounts of UV light, the author performed a simultaneous double-sided cure to prevent UV18S from being shadowed out.

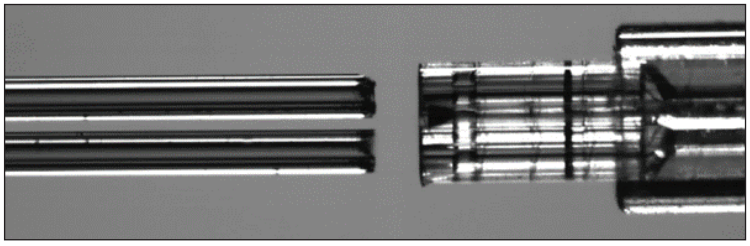

Figure 1. Two capillary supply lines (left) aligned with the mixing insert (right).

Results

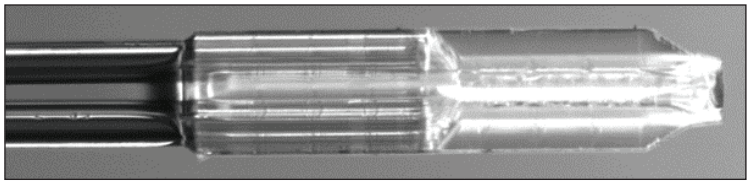

Figure 2. Mixing insert with the supply lines adhered into the port using UV18S after double-sided curing.

The author's new design provided an advantage over stopped-flow mixers, as it reduced the radiation damage to biomolecules from incident X-rays. Due to the longer sample pathlength of this mixer, time-resolved data could be obtained in only 100 seconds per scan, which permitted the measurement of many more delay times than is typically possible when using diffusive mixers. This design also used almost an order of magnitude less sample than turbulent mixers and completed the SAXS measurement in only three hours, which provided a massive improvement compared with other time-resolved setups, which require almost a day to collect a comparable amount of data. UV18S was critical to ensuring that the mixing assembly was bonded and sealed properly, without interfering with incident X-rays.

References

[1] Katz, A. M. (2018). *Sample saving techniques for solution X-ray scattering studies of biological macromolecules.* Cornell eCommons. https://hdl.handle.net/1813/59561