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Reprocessing and recycling of thermoset polymers based on bond exchange reaction

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ABSTRACT

Recently, it has been reported that by properly catalytic controlled bond exchange reactions, thermoset polymers could be welded by simple heating. During the operation, polymer topology could be rearranged in complying the external deformation and release the internal stress, but the network integrity is maintained and the average functionality of polymer chains is unchanged. This novel technology also enables us to reprocess and recycle the thermoset polymers. In this study, we experimentally demonstrated that after being milled into pulverous state in microsize, the thermoset epoxy polymer with exchangeable bond could be welded and assembled again into integrity with regained mechanical properties comparable to a fresh bulk polymer. The detailed operation procedure, as well as the influence of pressure and heating time on the stretch ability of the recycled polymer sample, is demonstrated. Such an in-depth reprocessing routine could be repeated for multiple times in manufacturing complex objects and welding separated bulk polymers. Considering the efficient and robust welding effect among polymer particles, as well as the maintained merits of thermoset polymer as stress-bearing materials during the operation, this new strategy is more suitable to repair polymer structures in service and recycle the thermoset waste in most engineering applications.