Full circle recycling of polysiloxanes via room temperature fluoride catalyzed depolymerization to repolymerizable cyclics

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Siloxane based polymeric materials are widely used all over the world due to their chemical, mechanical, and thermal stability, and low-toxicity. Despite their usefulness, a critical issue has been the accumulation of these materials in the environment. The need to recycle them effectively has thus far been challenging. The present methods used to recycle silicone-based materials, such as PDMS, involve high temperatures/pressures, and complicated setups. To address this issue, we have established an efficient room temperature technique for depolymerization of silicone-based polymers and resins in the presence of low catalytic amounts of fluoride in specific high swell organic solvents. The products primarily contain cyclic siloxane units (D4, D5, D6) as verified by GCMS and ^{29}Si NMR. Nearly any silicone resin can be depolymerized quite rapidly using our methods. Silicone rich systems result in the best conversions and the highest quantity of identifiable cyclics, while complex resins resulted in complicated products alongside discernable cyclics. We have also repolymerized the products from this process to reform silicones via acid, base and fluoride catalysis. Our discovery has the potential for large scale industrial processing due to the use of mild conditions and solvent recycling ability.

TOC Image: Depolymerization of Wacker Elastosil to cyclic siloxanes

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