Poly (lactic acid) (PLA) is a biobased and biodegradable polymer that is manufactured from plant-biomass resources. It is one of the few biobased polymers with excellent mechanical properties and clarity that can compete successfully with current fossil-based polymers in the marketplace. PLA can be recycled or composted (biodegradable under composting conditions) to provide for an environmentally responsible end-of-life option. Therefore, PLA is finding increasing use in food and single use disposable packaging and in industrial products where it offers significant value from economical as well as environmental perspectives.

PLA melt is characterized by a relatively low melt viscosity that prevents it from being readily processed in blown film unit operations. In general, blown film processing requires relatively high melt viscosity as well as nonlinear viscoelastic properties (strain hardening). In this study, we have synthesized a new modified PLA molecule containing reactive epoxy groups.
by reacting PLA with chain extenders (CE). Addition of this new reactive PLA molecule at low levels (5% to 10%) in to base PLA resin significantly improved the melt strength and processability of PLA into blown films. The reaction mechanism operating in this process was investigated. The rheological properties of the CE/PLA products were studies as a function of temperatures, process conditions and CE concentrations to provide fundamental data and processing parameters for successful blown films operation.

A viable end-of-life option for PLA is chemical recycling back to monomer – a virtual cycle of monomer to polymer and back to monomer – a circular biobased economy. Today’s industrial processes are based on the ring opening polymerization of the lactide monomer. Current approaches to PLA recycle is to hydrolyze it to lactic acid, purify it and then reform into lactide which can then enter into the polymerization step. However, we have shown that the polymerization of lactide to PLA follows a reversible kinetic model. We have used this reversible polymerization to recycle PLA to lactide monomer using catalytic thermal depolymerization with success. The mechanism and the rate of lactide formation from PLA as a function of time, temperature, and catalyst concentration using thermogravimetric analysis (TGA) were studied. The non-equilibrium depolymerization process leads to high yields of the desired lactide from PLA. The experimental depolymerization data fit a two-step reaction mechanism described by the Avrami equation. The model thus obtained provided all the critical parameters affecting this recycling process. Based on these data, a pilot plant of PLA recycling via thermal depolymerization is proposed. The sizing, energy balance, material balance and economic analysis were considered and included in this model recycling.

Finally, water soluble hydroxyl alkyl terminated silanes and polysiloxanes were prepared from the reaction of ethylene carbonates (or glycerol carbonate) and 3-
aminopropylalkoxysilanes. The kinetics of the hydrolysis reaction and subsequent condensation reactions under acidic conditions were studied in details using $^{29}\text{Si}$ NMR. Conventional polymerization of these hydroxyl alkyl terminated silanes yielded linear, branched or resinous siloxy polymers via self-polycondensation through exchange of the ethoxy groups attached to the silicon atom with the terminal hydroxyl groups. The synthesis of the silane monomers as well as the structure and key properties of the hydroxyl alkyl terminated siloxy polymers were investigated by DSC, $^1\text{H}$ NMR, FTIR, TGA and GPC.

Persons with disabilities have the right to request and receive reasonable accommodation. Please call the Department of Chemical Engineering and Materials Science at 355-5135 at least one day prior to the seminar; requests received after this date will be met when possible.