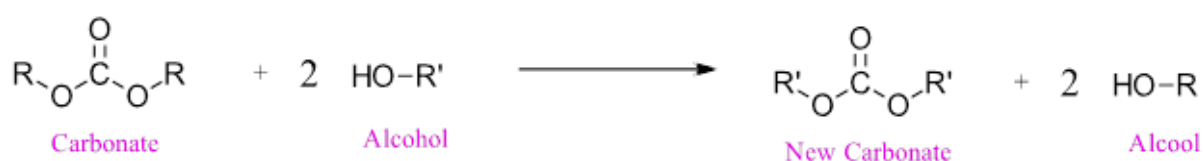


## M.Sc. Sem I, CC-2, Physical Chemistry

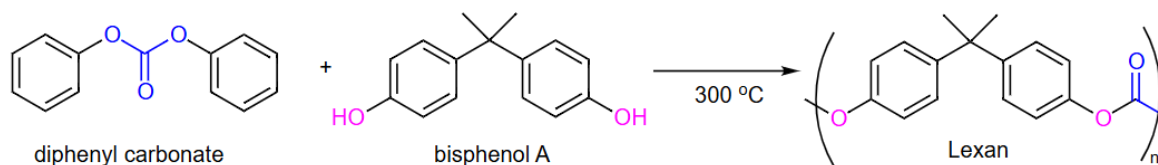
### Step-Growth Polymerization (continued...)

#### Polycarbonates

Beyond carboxylic acid derivatives, virtually any reaction which involves reactive species on two different molecules can be used to perform a step-growth polymerization. A variation involves using a monomer containing a carbonate functional group ( $-\text{O}-(\text{C}=\text{O})-\text{O}-$ ). A carbonate acts like a double ester and can undergo a type of double transesterification reaction with two alcohols to form a new carbonate containing compound.



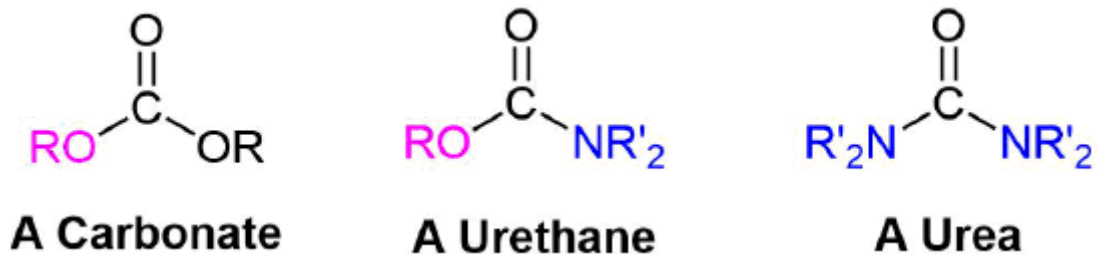
In effect, a carbonate is difunctional and can be reacted with a diol to form polymers containing repeated carbonate groups in their structure called polycarbonates. An example of a polycarbonate is the polymer, Lexan, which is created when diphenyl carbonate and bisphenol A (a diol) are reacted together.



Bisphenol (BPA), primarily used to make polycarbonate, is one of the highest-volume chemicals produced in the world, with over six billion pounds made each year. Because polycarbonate is used to make plastic bottles, the lining for food cans, and the lining for beverage cans there has been much concern about trace amounts of BPA leaching from the containers and being ingested. A study conducted in 2003 and 2004 by the Center for Disease Control and Prevention found trace amounts BPA in the tissues of 93% of people in the United States. Consequently, this has led to many beverage companies switching to non-polycarbonate polymers.

## Polyurethane

A urethane is a functional group similar to a carbonate and a urea. A urethane has an -OR and a -NR<sub>2</sub> group attached to the carbonyl carbon.



Polyurethane (PUR and PU) is a polymer composed of organic units joined by carbamate (urethane) links. Polyurethanes are produced by reacting an isocyanate containing two or more isocyanate groups per molecule ( $R-(N=C=O)_n$ ) with a polyol containing on average two or more hydroxyl groups per molecule ( $R'-(OH)_n$ ) in the presence of a catalyst or by activation with ultraviolet light.

