CHAPTER I
INTRODUCTION

Crystallization of semi-crystalline polymers is of great importance in polymer processing, because the resulting physical properties are strongly related to the morphology formed and the extent of crystallization. The crystallization of polymers is mainly controlled by nucleation and growth mechanisms. The nucleation rate depends on the number of heterogeneous nuclei (e.g., impurity, catalyst residue, additive, nucleating agents) present in the polymers.

Addition of nucleating agents into polymers has become an important method to accelerate crystallization process, consequently reducing processing time and/or improving optical and mechanical properties such as modulus, heat stability through the reduction of the spherulite size. However, the physical properties of particle (i.e., shape and surface area) as well as chemical characteristics are important factors affecting crystallization of polymers. Generally, various organic and inorganic particles are used as nucleating agents. Some of the widely used ones are, for examples, talc, mica, calcium carbonate ($CaCO_3$).

Syndiotactic polypropylene (s-PP) was successfully synthesized late in the last decade by using novel metallocene, instead of Ziegler-Natta, catalysis. This novel catalyst system has produced s-PP with much improved stereoregular structure, purity and yield. Possible applications of s-PP are in areas such as fibers and films. Since s-PP is a very slow crystallizing polymer, it is necessary to enhance its crystallization rate in order to shorten the processing time. In i-PP, $CaCO_3$ is frequently used as a nucleating filler. It is used to accelerate the crystallization process, improve mechanical properties and, at the same time, reduce material and processing cost. Therefore, it is of our interest to understand the processing-structure-property inter-relationships of $CaCO_3$-filled s-PP compounds.

The effect of nucleating agents on crystallization and mechanical properties of polymers has been extensively studied. There have been many reports on i-PP, but very few on s-PP. On s-PP, no report on the effect of nucleating agents on crystallization of s-PP is available in the open literature. The objective of this work is to study the effect of $CaCO_3$ with varying particle sizes, contents and surface

modifications to the crystallization behavior of s-PP under both isothermal and non-isothermal conditions, including mechanical properties and processability of the resulting compounds.