Topics

Polar Polyolefin

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Polyolefin is manufactured from ethylene, propylene and other monomers. It is used in a wide range of fields such as structural material for its low cost and good mechanical characteristics. Since polyolefin has low adhesion to adhesives and paints, however, it has a shortcoming in that it requires pretreatment with a primer before coating. To supplement this shortcoming, a functional group called a polar group containing oxygen and nitrogen atoms is introduced into the polyolefin. Since manufacturing a polar group-introduced polyolefin requires severe conditions of high temperature and pressure, in addition to the difficulty of carrying on production by controlling the molecular structure of the polymer, it is desired to manufacture polyolefin using a catalytic polymerization method that enables the fine molecular structure to be controlled under less severe conditions. However, an olefin polymerization catalyst loses its acitivity quite easily when trying to polymerize a monomer having a polar group with an olefin. Therefore, catalytic polymerization was not possible using conventional methods.

To solve this problem, we assumed that olefin polymerization would progress in the presence of a polar monomer if we disrupt the deactivation reaction between the polar group and the catalyst by masking the polar group, thereby preventing it from making contact with the catalyst. For masking the polar group, we used an organometallic compound. The organometallic compound and the polar group react quite easily, and the polar group can be masked well by using a bulky ligand coordinated to the metal. We masked a monomer containing the polar groups (carboxylic acid and alcohol) in the molecules with an organic aluminum (MAD) having a bulky ligand (**Figs. 1** and **2**). When we polymerized an olefin (ethylene) using an olefin polymerization catalyst (Ni catalyst) in the presence of the masked monomer, polymerization proceeded without catalyst deactivation. We discovered that a copolymer of ethylene and a masked monomer containing carboxylic acid and alcohol groups was formed (**Fig. 3**).

It is expected that by using MAD as the masking agent, it would be possible to introduce not only the carboxylic acid and alcohol functional groups but also the sulfonic acid and phosphonic acid groups that release proton (H^+) to the olefin. Some of these polar groups can be a proton conductor, making them important for operating as fuel, secondary batteries, sensor materials and other functions. In this connection, we expect that new opportunities will open up for using olefin as a functional rather than a structural material as it was mainly used thus far.

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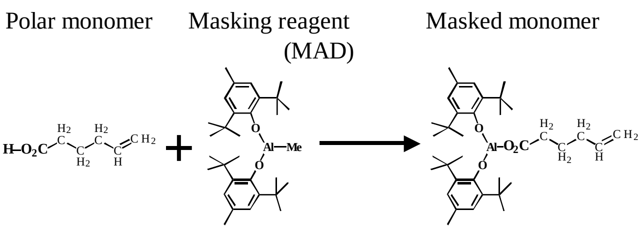

Fig. 1 Preparation of masked monomer.

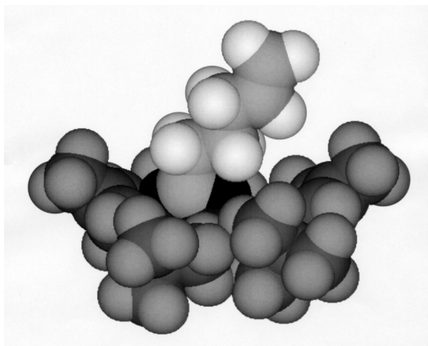

Fig. 2 Molecular structure of masked monomer.

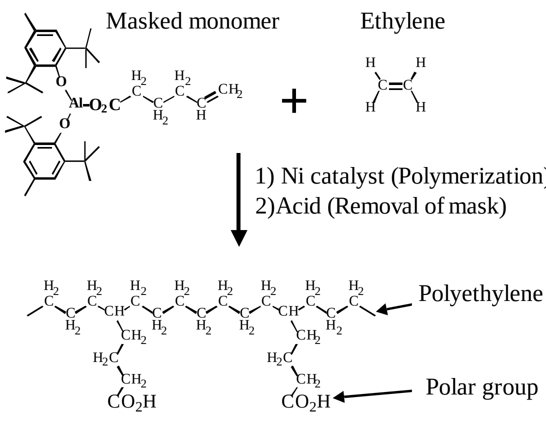

Fig. 3 Catalytic copolymerization of masked monomer and olefin.