In the light of designing microstructures of polyolefin for the advanced polyolefin materials, metal complex pre-catalysts have been widely investigated with being divided by employing either early-\(^1\) or late-transition metals.\(^2\) The industrious pre-catalysts are still focused on early-transition metal ones,\(^1\) and the academic core would target to CGC pre-catalysts\(^3\) and non-bridged half-metalloene pre-catalysts.\(^4\) Besides the nickel pre-catalyst has been used in a full-range ethylene oligomerization, namely as SHOP process,\(^5\) the late-transition metal complex pre-catalysts have extensively investigated within academic considerations. In current situation, less and less attentions have been drawn to late-transition metal pre-catalysts, therefore the chances for youth talents and funds have becoming less attractive. Pondering over publications of late-transition metal pre-catalysts in ethylene polymerization, especially relied on our cumulated results, their efficiencies and economic advantages enhance the highly potential applications. Moreover, the unique properties of their obtained polyethylenes could be easily recognized, targeting either advanced or functional polyolefin.

The typical iron complex pre-catalyst is bis(imino)pyridyliron dihalide,\(^2\) the extensive studies have approved the highly linear property of products obtained in ethylene polymerization or oligomerization. This would be helpful for high density polyethylenes,\(^6\) moreover, also highly possibly for the process of ethylene oligomerization.\(^7\) Regarding to polyethylenes obtained by iron and its cobalt analogs, the alternative application would be highly potential for polyethylene waxes due to low molecular polyethylenes with the advantages of linear and narrow polydispersity.\(^8\)

Though nickel complex pre-catalyst has be commercialized for ethylene oligomerization,\(^5\) our conclusive results would suggest the iron pre-catalysts instead of nickel ones. In addition, the advantages of nickel pre-catalysts should be re-considered in ethylene polymerization. The highly branched polyethylenes have been obtained,\(^9\) indicating new polymers for materials and the addicts in materials.

These polyethylenes could be classified in two characteristic polyethylenes: highly linear polyethylenes from waxes to highly density and high molecular, being produced by iron or cobalt complex pre-catalysts; and (super-)lower density polyolefins from waxes to highly branched high molecular, being produced by nickel complex pre-catalysts. At this stand, it would be important for more polymer physicists involved in studying the micro-structural and macro-property of these polyethylenes. With understanding the new properties, the usefulness and applications of these polyethylenes could be expected; then the scaling-up and commercializing processes of late-transition metal pre-catalysts would be promising.

It is no doubt of easy synthesis and better stability of late-transition metal complexes. In most cases, even not all catalytic systems, late-transition metal complex pre-catalysts could efficiently work by using alkylaluminum reagents instead of MAO or MMAO, therefore the pilot plants or industrial processes would be not difficult.

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