Current and future developements in alkene polymerization

- Synthesis of polyolefins with long chain branches;
- Synthesis of block copolymers via chain-shuttle polymerization;
- Nanocomposites based on polyolefins via *in-situ* polymerization;
- Ethylene/polar alkenes copolymerization.

Block copolymers via chain-shuttle polymerization
The new ***polyolefin block copolymer called INFUSE***
Dow Company

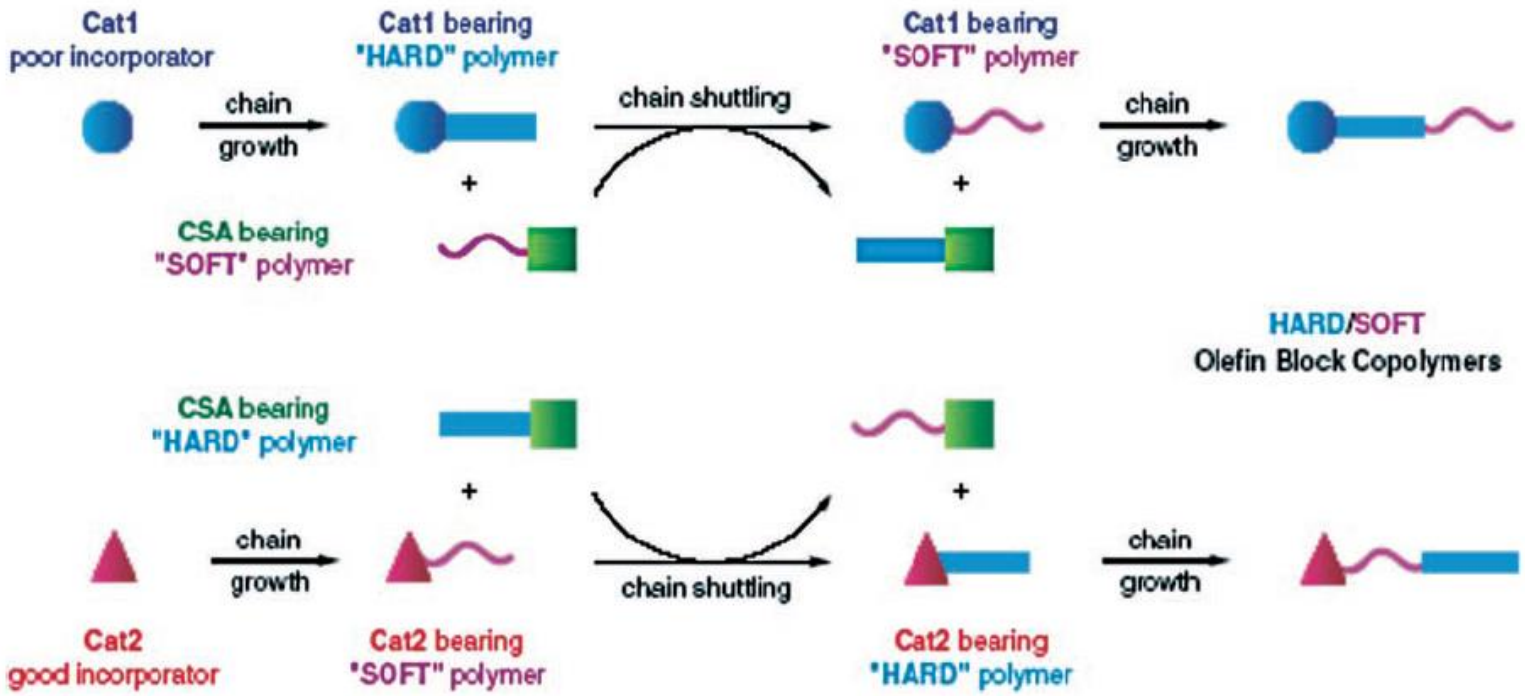
The principle:

Application at the same time, in the presence of a chain-shuttling agent, of two different catalysts, that when separately used would lead to structurally different polymers.

The name of *chain-shuttling defines the* ***REVERSIBLE*** *movement of the growing polymer chain between two different catalytic sites, in such a way that portions of the same polymer chain are synthesized by the two different catalysts.*

The two catalysts are featured by a different selectivity, that can be either a different stereoselectivity (stereoblocks polymers are obtained) or a different chemioselectivity towards two monomers (polymer with blocks differing in the composition are obtained).

Chain-shuttle polymerization



The synthesis of copolymers with blocks differing in the composition via chain-shuttling is realized by using a mixture of two monomers and choosing two catalysts that have a different chemoselectivity towards the two monomers.

The target was to obtain a block copolymer featured by alternating blocks of crystalline and amorfous polymers: obtaining a hard and soft copolymer.
The two monomers used are ethylene and 1-octene: the PE with a low content of 1-octene is a semicrystalline polymer (hard) with Tm = 135 °C; the PE with a high content of 1-octene is an amorfous polymer (soft) with Tg < -40 °C.

A three component system is applied. Features of the three components:

- **Being active under the same reaction conditions;**
- **Do not be the poison of one each other;**
- **The chain-shuttling agent must act in this way towards both catalysts;**
- **The chain-shuttling process must be REVERSIBLE.**

The catalytic system is very *versatile*

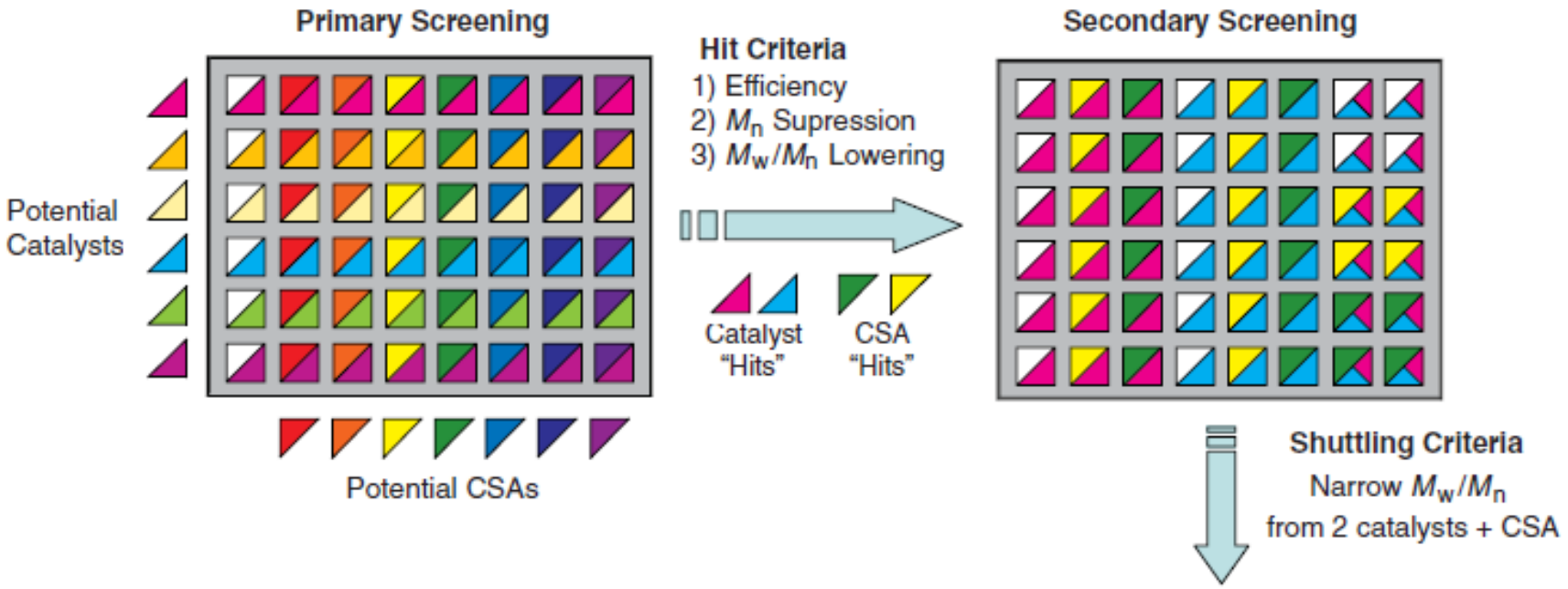
- the hard/soft ratio in the polymer is controlled by the relative amount of the two catalysts;

- the content of the two monomers in the relavant blocks is controlled either by the content of the two monomers in the starting mixture or by varying the catalyst;

- the average length of the blocks is controlled by the [CSA]/[monomer] ratio.

The discovery of the catalyst:

Combinatorial catalysis and high-throughput screening



Post-metallocene catalysts