Electronic Supplementary Information (ESI) for RSC Advances.

Silyl diol ester as a new selectivity control agent in MgCl$_2$-supported Ziegler-Natta systems for Propylene polymerization: catalyst structure and polymer properties

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Figure S1 Synthetic route of silyl diol ester

Figure S2 Synthetic route of 9, 9-bis (methoxymethyl) fluorene
Figure S3 SEM photograph of cross-section of catalyst A3 particle and the element distribution data. The curves on the particle are the element distributions along the line (top to bottom): Cl, Mg, Si and Ti.
Figure S4 Molecular weight distribution of catalysts: B and A₃
Figure S5: Effect of ED/cat ratio on fraction percentage of different sites
Table S1. Effect of the ED/cat ratio on the performances of the catalyst catalyst A

| ED\(^a\)/Cat | 0    | 0.5  | 0.66 | 1    |
|-------------|------|------|------|------|
| Activity\(^b\) | 2.06 | 1.3  | 1.53 | 1.48 |
| I.I (\%)\(^c\)  | 97.6 | 96.3 | 97.4 | 96.3 |
| \(M_n\)       | 84000| 141000| 152000| 134600|
| \(M_w\)       | 647000| 964000| 943000| 887000|
| PDI           | 7.71 | 6.85 | 6.22 | 6.59 |

*external donor: C-donor; \(^b\) polymerization conditions: 20 mg catalyst, TEA/cat: 10, \(^c\) xylene solubility.

Table S2. Effect of the TEA/cat ratios on the performances of the catalyst A

| TEA/Cat | 5    | 10   | 20   |
|---------|------|------|------|
| Activity| 0.98 | 1.53 | 1.39 |
| I.I (\%)\(^b\)  | 95.6 | 97.4 | 96.72|
| \(M_n\)       | 133000| 152000| 76000|
| \(M_w\)       | 943000| 943000| 758000|
| PDI           | 7.07 | 6.22 | 10.00|

*Polymerization conditions: 20 mg catalyst, ED/cat= 0.66, external donor: C-donor, \(^b\) xylene solubility.
Table S3. Hydrogen response of catalysts: A₃, D and B

| Catalyst | H₂ (mmol) | Activity | I.I  | MFR  |
|----------|-----------|----------|------|------|
| D        | 2.25      | 2.69     | 98.7 | 16.91|
| D        | 4.5       | 4.32     | 99.3 | 24.1 |
| D        | 9         | 3.94     | 98.74| 57.88|
| D        | 13.5      | 2.11     | 98.74| 117.38|
| A₃       | 1.12      | 2.45     | 98.78| 4.55 |
| A₃       | 2.25      | 3.48     | 96.66| 7.18 |
| A₃       | 4.5       | 2.02     | 96.03| 14.9 |
| A₃       | 6.75      | 2.16     | 95.68| 21.1 |
| A₃       | 13.5      | 3.40     | 93.97| 67.1 |
| B        | 2.25      | 4.34     | 99.7 | 17.85|
| B        | 4.5       | 3.75     | 99.2 | 35.37|
| B        | 9         | 4.04     | 98.46| 120.44|

Table S4. Result of deconvolution the MWD curve of catalysts: A₃ and B

| Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|--------|--------|--------|--------|--------|--------|
| Catalyst | Fₐ   | Mₐ   | Fₐ   | Mₐ   | Fₐ   | Mₐ   | Fₐ   | Mₐ   |
| B       | 20.8  | 2.43  | 35.56 | 6.64  | 28.53 | 17.89 | 15.11 | 46.29 |
Table S5. Effect of ED/cat ratio on active centers of catalyst A₃

| TEA/Cat | TEA/ED | Fᵣᵃ | Mᵸᵇ | Fᵣ | Mᵸ | Fᵣ | Mᵸ | Fᵣ | Mᵸ | Fᵣ | Mw |
|---------|--------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|
| 10      | 0      | 5.53 | 1.18 | 22.88 | 3.61 | 29.93 | 10.97 | 28.87 | 37.32 | 12.79 | 130.98 |
| 10      | 10     | 10.96 | 2.61 | 21.67 | 7.97 | 32.3 | 26.69 | 22.72 | 62.67 | 12.34 | 157.26 |
| 10      | 15     | 10.81 | 3.03 | 23.45 | 8.73 | 28.43 | 26.45 | 24.11 | 61.84 | 13.2 | 171.22 |
| 10      | 20     | 9.74  | 2.79 | 21.30 | 7.9 | 25.37 | 21.77 | 31.89 | 59.71 | 11.69 | 190.95 |

ᵃFᵣ was the weight percentage of the fraction produced by a certain active center in catalyst.
ᵇ Weight average molecular weight, in 10⁴ g/mol.
