Electronic Supplementary Material (ESI) for Catalysis Science & Technology

Supporting Information for:

3D-QSPR Models for Predicting the Enantioselectivity and the Activity in Asymmetric Hydroformylation of Styrene Catalyzed by Rh-diphosphane.

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Algorithms and technical details

Description of the of the conformational search protocol: It consists of (i) initial QM/MM optimization at BP86:SYBYL level, (ii) 100 ps of restricted MD simulation fixing the rhodium coordination sphere at 1000 K, sampling a geometry each ps, (iii) 100 partial geometry optimizations fixing the Rh coordination sphere to select the 10 lowest energy geometries, and (iv) final full geometry optimization of the selected structures at BP86:SYBYL level.

Algorithm for the filtering of basic points based on MEP field. The correction procedure is defined as follows: i) random selection of nodes, ii) evaluation of a quality value (from 0 to 1), which depends on the MEP values and the distance between each pair of nodes, iii) iteratively exchange of nodes showing the worst individual quality values until the global quality value behaves asymptotically, and iv) choosing the node selection with the best quality values.

Enantioselectivity model generated with empirical probes with ALMOND software. To check the robustness of our methodology further in correlating with enantioselectivity, we generated a new mathematical model using ALMOND software, in which GRIND methodology is also implemented. The alignment-independent descriptors were built from the empirical *TIP* interactions generated with *C3* probes (an atom of carbon with sp^3 hybridization). The *TIP* was computed using a grid-spacing 0.3 Å and the grid extending 1.4 Å beyond molecule boundaries. The QSPR model showed an acceptable predictive capability (q^2=0.59 and r^2=0.96 for the optimal number of PLS, 5 components).

Algorithm for selection of the subsets in external validation. The procedure consists of: i) all catalysts were sorted in ascending %*ee* value order, ii) for each i^{th} run, the first test object was the one ranked at position i^{th} of the sorted data, iii) then 5 iterations were carried out for selecting those ranked at $i^{th} + j^{th} * 5$, where j^{th} starts at 1 and it is incremented by one in each iteration while $i^{th} + j^{th} * 5$ is lower than the size of the set.

Table S1. Relative energies (in kJ.mol^{-1}) of isomers **ee$_1$**, **ee$_2$**, **ea** to the complex [RhH(CO)$_2$(P-P)].

	E_{rel} (kJ.mol^{-1})		
Ligand	**ee$_1$**	**ee$_2$**	**ea**
1	14.7	-	0.0
2	24.1	-	0.0
3	19.3	-	0.0
4	16.6	-	0.0
5[1]	18.0	15.7	0.0
6	14.0	-	0.0
7	67.1	-	0.0
8	33.9	27.1	0.0
9	16.7	16.1	0.0
10	24.0	-	0.0
11	0.0	-	18.6
12	5.9	-	0.0
13	10.0	-	0.0
14	22.7	-	0.0
15	18.1	-	0.0
16	11.4	-	0.0
17	13.5	-	0.0
18	41.1	-	0.0
19	14.2	-	0.0

[1]There are two isomers **ea** (**ea$_1$**, **ea$_2$**), the table reflects the value of the thermodynamically more stable isomer **ea**.

Figure S1. The coefficients of QSPR equation to predict the enantioselectivity of asymmetric hydroformylation of styrene catalyzed by Rh-diphosphane.

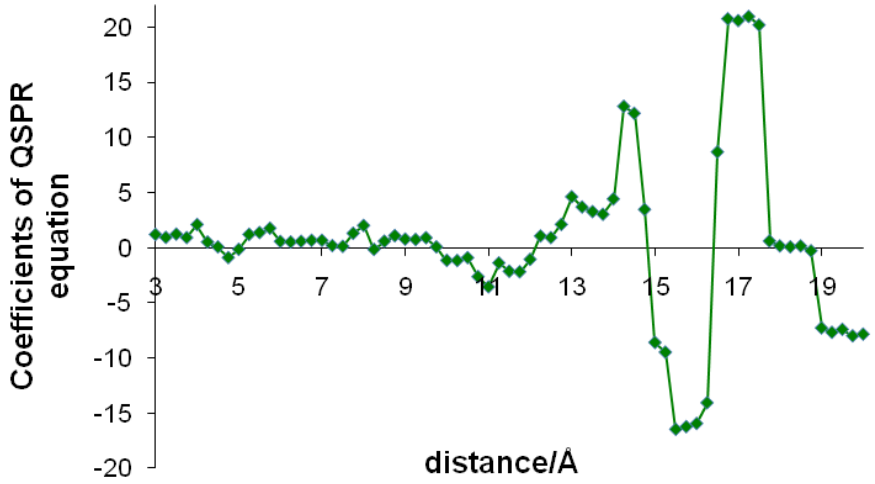

Figure S2. The coefficients of QSPR equation to predict the activity of asymmetric hydroformylation of styrene catalyzed by Rh-diphosphane. The green and red lines refer to MEP-MEP$_{CONV}$ and MEP-MEP$_{BAS}$ descriptors, respectively.

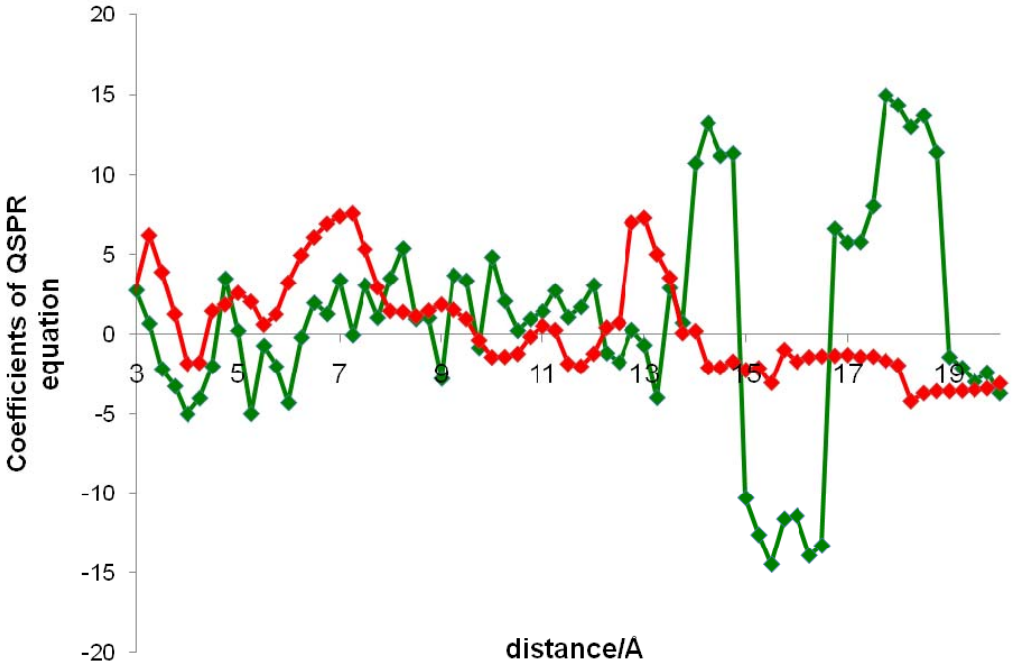

Figure S3. Backtracking of the most important MSF-MSF variables of the enantioselectivity model of Rh-YANPHOS catalyst.