SUPPORTING INFORMATION

Enantio-differentiation of Molecules with Diverse Functionalities by a Single Probe

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Experimental section

The commercially available (1S,2S) -N,N'-Dihydroxy-N,N'-bis (diphenylacetyl)-1,2- cyclohexanediamine ((S)-CBHA-DPA), the molecules 1-24, and chloroform-d were purchased and used as received. The $^1$H and $^{13}$C NMR spectra were recorded on 400MHz spectrometer and referenced with respect to TMS. The pure shift NMR spectra were recorded on 500 MHz spectrometer.
400MHz $^1$H-NMR spectrum of (R/S)-2-chloropropanoic acid and (S)-CBHA-DPA in CDCl$_3$
400MHz $^1$H-NMR spectrum of (R/S) - Mandelic acid and (S)-CBHA-DPA in CDCl$_3$. 

![NMR spectrum diagram]

S3
400MHz $^1$H-NMR spectrum of (R/S) - 4-(Trifluoromethyl) mandelic acid and (S)-CBHA-DPA in CDCl$_3$
400MHz $^1$H-NMR spectrum of (R/S)-N-Methyl-1-(1-naphthyl)ethylamine and (S)-CBHA-DPA in CDCl$_3$.
400MHz $^1$H-NMR spectrum of (R/S)-4-phenyloxazolidin-2-one and (S)-CBHA-DPA in CDCl$_3$
400MHz $^1$H-NMR spectrum of (R/S)-4-phenyloxazolidine-2-thione and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H-NMR spectrum of (R/S)-1-(p-tolyl)ethanamine and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H-NMR spectrum of (R/S)-2-methylpiperidine and (S)-CBHA-DPA in CDCl$_3$
$^{1}H$-NMR spectrum of (R/S)-N,N dimethyl 1-phenyl ethylamine and (S)-CBHA-DPA in CDCl$_3$ at 298K
400 MHz $^1$H-NMR spectrum of (R/S) – N,N dimethyl 1-phenyl ethylamine and (S)-CBHA-DPA in CDCl$_3$ at 233K
400 MHz $^1$H -NMR spectrum of (R/S)-2-Amino-1-butanol and (S)-CBHA-DPA in CDCl$_3$. 

S12
400 MHz $^1H$-NMR spectrum of (R/S)-1-chloro 2-propanol and (S)-CBHA-DPA in CDCl$_3$ at 233K
400 MHz $^1$H -NMR spectrum of (R/S)–Mandelonitrile and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H-NMR spectra of (R/S)-1-Phenylethane-1, 2-diol, DMAP and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H -NMR spectrum of (R/S) –Epichlorohydrin and (S)-CBHA-DPA in CDCl$_3$ 233K
400 MHz $^1$H -NMR spectra of (R/S)-1,1'-Binaphthyl-2,2'-diyl hydrogenphosphate, DMAP and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H -NMR spectrum of (R/S) – Propylene carbonate and (S)-CBHA-DPA in CDCl$_3$
400MHz $^1$H-NMR spectrum of (R/S) - Methyl phenyl sulfoxide and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H-NMR spectrum of (R/S) - 2-bromosuccinic acid and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H-NMR spectrum of (R/S) - 2-methyl piperazine and (S)-CBHA-DPA in CDCl$_3$
$^{1}H$-NMR spectrum of (R/S) – Methyl DL-mandelate and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H-NMR spectrum of (R/S) – Isopropyl alcohol and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H -NMR spectrum of (R/S) – 2-fluoro benzyl amine and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H-NMR spectrum of (R/S) – 2-fluoro benzyl amine and (S)-CBHA-DPA in CDCl$_3$ at 233K.
$400 \text{ MHz } ^1\text{H}{\text{-}}\text{NMR spectrum of (R/S) – Isopropyl amine and (S)-CBHA-DPA in CDCl}_3$
400 MHz $^1$H-NMR spectrum of (R/S) – Isopropyl amine and (S)-CBHA-DPA in CDCl$_3$ at 233K

\[
\text{NH}_2
\]
400 MHz $^1$H-NMR spectrum of (R/S) - Isobutyric acid and (S)-CBHA-DPA in CDCl$_3$
400 MHz $^1$H -NMR spectrum of (R/S) – Isobutyric acid and (S)-CBHA-DPA in CDCl$_3$ at 233K
400 MHz $^1$H-NMR spectrum of (R/S) – 2-Amino-2-methyl-1-propanol and (S)-CBHA-DPA in CDCl$_3$
$^{19}$F-NMR spectrum of (R/S) – 4-(Trifluoromethyl)mandelic acid and (S)-CBHA-DPA in CDCl$_3$
$^{13}$C–NMR spectrum of $(R/S)$–Mandelonitrile and $(S)$-CBHA-DPA in CDCl$_3$

Table: $^1$H-NMR spectrum pertaining to a specific proton of different chiral analytes showing discrimination and their chemical structure
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<thead>
<tr>
<th>Entry</th>
<th>Guest</th>
<th>Spectrum</th>
<th>Entry</th>
<th>Guest</th>
<th>Spectrum</th>
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400MHz $^1$H-NMR spectrum of $(R/S)$-2-methylpiperidine and (S)-CBHA-DPA (1:2) in CDCl$_3$
500MHz $^1$H-NMR spectrum of (R/S)-2-methylpiperidine and (S)-CBHA-DPA (1:2) in C$_6$D$_6$
500MHz $^1$H-NMR spectrum of ($R$/S)-2-methylpiperidine and (S)-CBHA-DPA (1:2) in toluene-$d_8$(C$_7$D$_8$)
500MHz $^1$H-NMR spectrum of (R/S)-2-methylpiperidine and (S)-CBHA-DPA (1:2) in methylenechloride-$d_2$(CD$_2$Cl$_2$)
500MHz $^1$H-NMR spectrum of (R/S)-2-methylpiperidine and (S)-CBHA-DPA (1:2) in acetonitrile-\textsubscript{d$_3$} ($C_2D_3N$)
400MHz $^1$H-NMR spectrum of $(R/S)$-2-methylpiperidine and $(S)$-CBHA-DPA (1:2) in 10% DMSO in CDCl$_3$
400MHz $^1$H-NMR spectrum of (R/S)-2-methylpiperidine and (S)-CBHA-DPA (1:2) in 20% DMSO in CDCl$_3$
Chemical shift difference for the selected proton of (R/S)-2-methylpiperidine with (S)-CBHA-DPA (1:2) in different solvents

[Chemical structure diagram]

<table>
<thead>
<tr>
<th>S.No</th>
<th>Solvent</th>
<th>$\Delta \delta^{RS}$ (ppm)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>CDCl$_3$</td>
<td>0.05</td>
</tr>
<tr>
<td>2</td>
<td>C$_6$D$_6$</td>
<td>0.05</td>
</tr>
<tr>
<td>3</td>
<td>TOLUENE-d$_8$</td>
<td>0.05</td>
</tr>
<tr>
<td>4</td>
<td>CD$_2$Cl$_2$</td>
<td>0.04</td>
</tr>
<tr>
<td>5</td>
<td>CD$_3$CN</td>
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</tr>
<tr>
<td>6</td>
<td>10% DMSO in CDCl$_3$</td>
<td>0.01</td>
</tr>
<tr>
<td>7</td>
<td>20% DMSO in CDCl$_3$</td>
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Comparing the present CA with other CAs in the literature

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<th>Literature Reference</th>
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<td>![CN]</td>
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<td>Present method</td>
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<tr>
<td>![NH₂]</td>
<td>0.07</td>
<td>Present method</td>
</tr>
<tr>
<td>![COOH]</td>
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<td>Present method</td>
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<tr>
<td>![Ph]</td>
<td>0.02</td>
<td>L. S. Moon, R. S. Jolly, Y. Kasetti and P. V Bharatam, <em>Chem. Commun. (Camb)</em>, 2009, 1067</td>
</tr>
<tr>
<td>![Cl]</td>
<td>0.05</td>
<td>Present method</td>
</tr>
<tr>
<td>![Cl]</td>
<td>0.024</td>
<td>L. S. Moon, R. S. Jolly, Y. Kasetti and P. V Bharatam, <em>Chem. Commun. (Camb)</em>, 2009, 1067</td>
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<td>![O]</td>
<td>0.01</td>
<td>Present method</td>
</tr>
<tr>
<td>![Cl]</td>
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<td>Present method</td>
</tr>
</tbody>
</table>
| Structure | 1) 0.03 | 2) 0.02 | 1) Present method  
|-----------|---------|---------|----------------------------------------------------------------|
| Structure | 1) 0.06 | 2) 0.05 | 1) Present method  
| Structure | 1) a 0.04, b 0.09 | 2) a 0.01, b 0.05 | 1) Present method  
| Structure | 19F | a 1) 0.03, 2) 0.033, 3) 0.03 | 1) Present method  
The experimentally determined and laboratory prepared scalemicratios of \((R/S)\) – Mandelic acid and \((S)\)-CBHA-DPA. Alpha proton was chosen to measure \(ee\).

<table>
<thead>
<tr>
<th>Entry</th>
<th>Integration (I_R:I_S)</th>
<th>Gravimetrically prepared excess of (R) enantiomer</th>
<th>(ee% = \frac{I_R-I_S}{I_R+I_S} \times 100)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>1.000:0.043</td>
<td>92</td>
<td>91.7</td>
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<tr>
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<td>89.9</td>
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<tr>
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<td>1.000:9.048</td>
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<td>80.0</td>
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<td>15.3</td>
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<td>-29.9</td>
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<td>-89.8</td>
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<tr>
<td>8</td>
<td>1.000:0.251</td>
<td>60</td>
<td>59.8</td>
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400 MHz $^1$H-NMR spectra of selected regions of different scalemic ratios of $R$-mandelic acid and $S$-mandelic acid in CDCl$_3$. 
500MHz $^1$H-NMR spectrum of (S)-CBHA-DPA in CDCl$_3$
Pure shift NMR experimental details:

**Pure shift NMR experiment:** The pure shift spectroscopy suppresses the effects of homonuclear coupling, allowing $^1$H spectra to be produced that contain chemical shifts only, with no multiplet structure, a major improvement in the resolution. The pure shift experiment was performed on 500 MHz Bruker spectrometer by using “push1dzs” pulse program which is available in the public domain of the Manchester NMR methodology group website (http://nmr.chemistry.manchester.ac.uk). This pulse program produces a pseudo 2D experiment where the delay between excitation and detection is incremented stepwise. The refocusing step was carried out using rsnob shaped pulse combined with slice selection gradient strength of 0.7 to 0.9 G cm$^{-1}$. Each of the 32 increments in $t_1$ was acquired with 8 scans with a recycle delay of 2 s between two successive fids. The total time domain points in $t_2$ dimension are 2K. Data was processed with the AU program named pshift present at the same website (http://nmr.chemistry.manchester.ac.uk). The AU program converts the raw data to pure shift FID. The spectra were recorded in CDCl3 at 298K.