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Synthesis and Reactivity of Functionalized Bridged *m*-Xylylenedioxycalix[6]arenes

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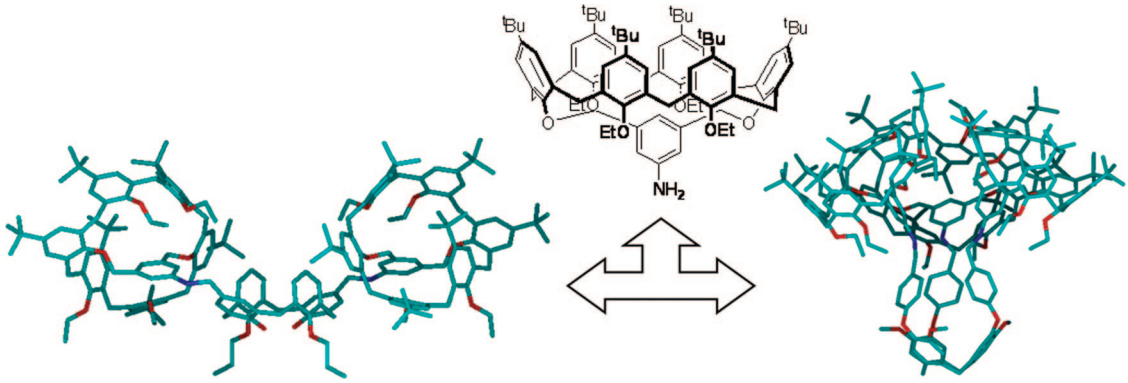

The synthesis of A,D-*m*-xylylene-bridged calix[6]arenes **1**−**8** functionalized at position 5 of the spacer arm is described. The *cone* conformation of the new bridged calix[6]arenes has been established by ^{1}H and ^{13}C NMR. The X-ray structure of compound **6** confirmed the *cone* conformation also in the solid state. Compounds **9** and **10**, which are branched-like structures, were obtained by reductive amination of 5-amino-A,D-*m*-xylylene-bridged-B,C,E,F-tetra-*O*-ethylcalix[6]arene **7** with diformyl calix[4]arene and CTV derivatives **22** and **24**, respectively.

Introduction

The development of receptors based on calixarenes requires an efficient control of the conformational flexibility of these cyclic phenol oligomers.[1] Different strategies have been used aimed at restricting the mobility of calix[6]arenes, since inversion of the rings can also take place by rotation of the *para*-substituent (even a *tert*-butyl group) through the annulus.[2] The most common method to prevent these rotations is to bridge two or three phenol rings by appropriate spacers,[3] and several examples have been reported with xylylene,[4] 9,10-anthrylene,[4a] durylene,[4a] or pyridine[5] spacers. Spacers derived from *m*-xylylene or 2,6-lutidinediyl have been found to better keep the A and D rings in a *syn* orientation, although the relative direction of the remaining four rings depends on their O-substitution. Whereas the free phenols favor a *cone* conformation due to

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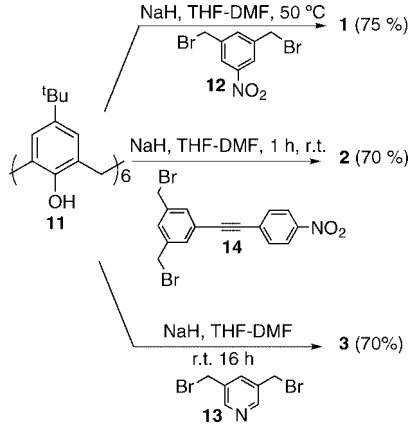
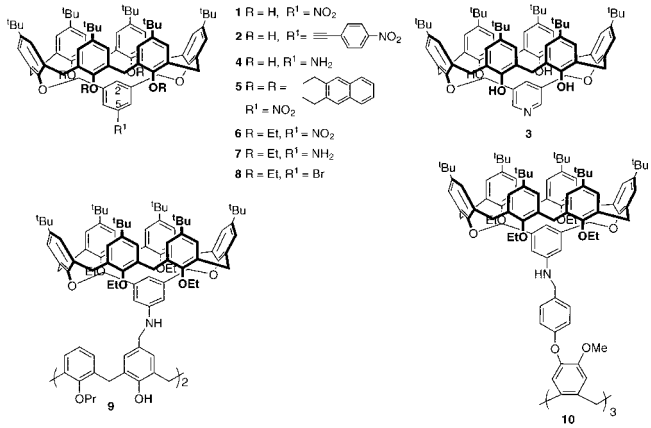
SCHEME 1. Synthesis of Compounds 1−3



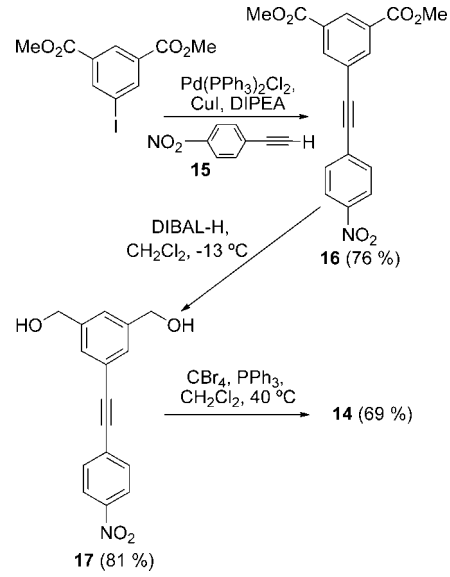
hydrogen bonding, small substituents such as OMe result in a flexible structure in all cases.[4c] However, introduction of OEt groups does not seem to have the same effect, since a *cone* conformation is obtained with the *m*-xylylene spacer,[4g] and mixtures of conformations result with *p*-xylylene and 2,6-lutidinediyl spacers.[5b] On the other hand, the presence of bulky substituents such as a bromine in position 2 of the spacer disfavors the *cone* because it does not fit well inside the cavity.[4f,g,6] The use of the *m*-xylylene spacer to link opposite rings allows the introduction of an additional function in position 5, facilitating the attachment to other calixarene or cyclotriveratrylene (CTV) platforms. Use of these building blocks might be an efficient strategy to construct dendrimeric structures that possess definite cavities if a concave rigid platform is employed to direct the calix[6]arene arms to the same side of the plane. An example has been recently reported with a flat platform as the linker between calixarenes.[7] We describe herein the synthesis of compounds **1**−**4**, with different spacers functionalized in position 5, and compounds **5**−**8**, where all rings contain *O*-alkyl groups. The conformational study demonstrates that these compounds display rigid *cone* conformations. Finally, we have studied the reactivity of **7** with carboxylic acids and aldehydes giving rise to branched structures **9** and **10**.



Results and Discussion

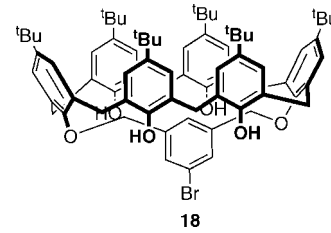
Synthesis. Compounds **1**−**3** were obtained in good yields by O-alkylation of *p-tert*-butylcalix[6]arene **11**[8] with dibromides **12**−**14**, respectively, in the presence of NaH and a THF−DMF (9:1) mixture (Scheme 1).

SCHEME 2. Synthesis of Compound 14



Dibromides **12**[9] and **13**[10]are known compounds, and derivative **14** was obtained from dimethyl 5-iodo-isophthalate by a Sonogashira coupling reaction,[11] followed by reduction and bromination of the resulting alcohols (Scheme 2).

O-Alkylation of **1** with 2,3-bis(bromomethyl)naphthalene[12] or ethyl iodide gave compounds **5** and **6** in 30% and 68% yields, respectively. Similarly, *O*-alkylation of **18**[4e] with ethyl iodide gave **8** in good yield.



Compounds **1**, **2**, **5**, and **6** possess a nitro group as a precursor of an amine, whereas **8** possesses a bromine atom as a precursor of a carboxylic acid. These functionalities allow an easy growth of the structure by covalently attaching several calixarenes through amide or urea linkers.

Reduction of **1** with hydrazine in 2-propanol resulted in the hydrogenolysis product **11** instead of the desired amine, whereas the reaction proceeds as expected from the tetra-*O*-ethyl compound **6**, producing **7** in a 74% yield. It is likely that in this case the presence of the ethyl groups hinder the access of the reagent to the benzyl positions, preventing the hydrogenolysis. The alternative reduction of **1** and **6** with $SnCl_2$ in 2-propanol gave the expected amines **4** (87%) and **7** (78%), respectively. Attempts to reduce the nitro group in **5** under the same

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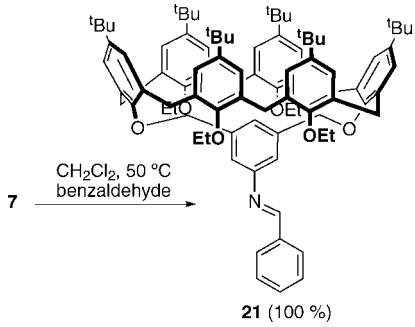
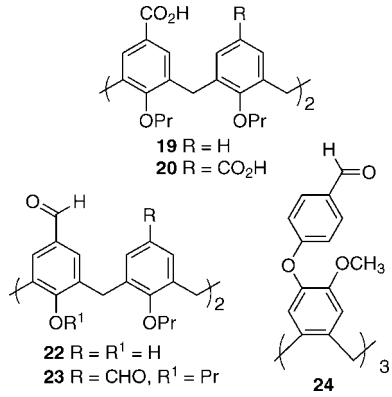
(12) Futamura, S.; Zong, Z. M. *Bull. Chem. Soc. Jpn.* **1992**, *65*, 345–348.

SCHEME 3. Synthesis of Compound 21



conditions failed, however, presumably due to the protection of the aromatic walls of the outer spacers toward the access of any reagent.

On the other hand, treatment of **8** with *tert*-butyllithium followed by addition of CO_2 gave rise to a complex mixture where the starting material was the major product (mass spectrometry analysis). This illustrates again the hindering effect of the *O*-ethyl groups. This was further corroborated by the unsuccessful attempts to form an amide by reaction of amine **7** with *p*-methoxybenzoic acid or with carboxylic acids **19**[13a] and **20**[13b] under a variety of coupling conditions (oxalyl chloride, EDC, or PyBOP). In all cases the starting material was recovered or a complex reaction mixture was obtained.



To overcome these difficulties, the formation of imines was tested, taking advantage of the greater reactivity of aldehydes with respect to carboxylic acids. Thus, the model imine **21** was obtained quantitatively from amine **7** and benzaldehyde (Scheme 3).

However, when amine **7** was reacted with dialdehyde **22**,[13a] the resulting imine was easily hydrolyzed during the isolation process. Also, reaction with tetraaldehyde **23**[14] gave rise to a complex mixture from which the target compound could not be isolated. In this case, the steric hindrance caused by the incorporation of the bulky calix[6]arene on the calix[4]arene platform is likely the reason for the reaction not be completed.

Secondary amine formation (through reductive amination) was then considered in order to establish if imines could not be obtained due to either steric hindrance or hydrolysis during purification. Reaction of amine **7** with dialdehyde **22**[13a] in the presence of $NaBH(AcO)_3$ gave diamine **9** in 70% yield. An attempt to perform a similar reaction with tetraaldehyde **23**[14] yielded, after 10 days, a mixture of compounds where up to three or even four calix[6]arene units, in various reduction states, had been incorporated (mass spectrometry analysis). These results point to steric hindrance as the major cause for reaction failure or incompletion.

TABLE 1. NMR (500 MHz, $CDCl_3$, 298 K) of Compounds 1−8

	^{13}C NMR (ppm) ($ArCH_2Ar$)	^{1}H NMR (ppm) AX systems ($ArCH_2Ar$)	^{1}H NMR (ppm) ArH (H-2 of spacer)
1	33.1 and 32.8	4.25 and 3.53 (8H) 4.28 and 3.35 (4H)	8.87
2	33.2 and 33.0	4.31 and 3.52 (8H) 4.19 and 3.35 (4H)	8.58
3	32.1 and 31.9	4.19 and 3.44 (8H) 4.08 and 3.26 (4H)	8.79
4	33.2 and 33.0	4.32 and 3.47 (8H) 4.18 and 3.31 (4H)	7.92
5	32.2 and 30.5	4.52 and 3.65 (8H) 4.22 and 3.01 (4H)	6.54
6	30.2 and 28.7	4.47 and 3.45 (8H) 4.31 and 3.24 (4H)	5.66
7	30.2 and 29.7	4.45 and 3.44 (8H) 4.36 and 3.25 (4H)	4.76
8	30.2 and 29.7	4.44 and 3.44 (8H) 4.34 and 3.25 (4H)	5.27

The rigid, C_{3v}-symmetric CTV-derived trialdehyde **24**[15] was chosen next considering its more open shape compared with calix[4]arenes in *cone* conformation.[16] The reaction between **24**[15] and a large excess of amine **7** gave compound **10** in 12% yield after 11 days reaction. The low yield was partly due to difficulties in isolation in the presence of the excess amine employed, which caused overlap between compounds of similar molecular weight in size exclusion chromatography columns, the most effective method found for the isolation of **10**.

Conformational Analysis. The conformations of the new bridged calix[6]arenes were established by a full set of 1D and 2D ^{1}H or ^{13}C NMR techniques. The NMR spectra of compounds **1**−**8** ($CDCl_3$, 300 K) showed the signals corresponding to molecules with two planes of symmetry: two AX systems in a 2:1 ratio for the methylene protons ($ArCH_2Ar$) and the corresponding two signals in ^{13}C NMR around 28−33 ppm, indicating that the macrocycles display *cone* conformations in all cases (Table 1).[17] Furthermore, these spectra remain invariable even if the temperature is raised up to 403 K ($C_2D_2Cl_4$).

The aromatic proton H-2 of the *m*-xylylene spacer in *O*-alkyl compounds (**5**−**8**) is abnormally shielded ($\Delta\delta \sim 3.00$ ppm) with respect to those who have the free phenols (**1**−**4**). In addition, the shifts found in their ^{13}C NMR spectra for the methylene groups ($ArCH_2Ar$) appear at higher fields relative to the analogue compounds **1**−**4** (e.g., 33.1 and 32.8 ppm for **1** and 30.2 and 28.7 ppm for **6**) (Table 1). These effects could be the result of the O-alkylation that promotes both the introduction of the aromatic ring of the *m*-xylylene spacer into the cavity and the loss of the hydrogen bonding network, which orient

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(16) The size of the cavity is defined by the angle δ between the aromatic rings and the plane formed by the carbon atoms of the methylene bridges. In CTVs $\delta = 132°$ (Collet, A. In *Comprehensive Supramolecular Chemistry*; MacNicol, D. D., Toda, F., Bishop, R., Eds.; Pergamon: Oxford, 1996; Vol. 6) and in calix[4]arene $\delta = 115°$ (Arduini, A.; Nachtigall, F. F.; Pochini, A.; Secchi, A.; Ugozzoli, F. *Supramol. Chem.* **2000**, *12*, 273−291).

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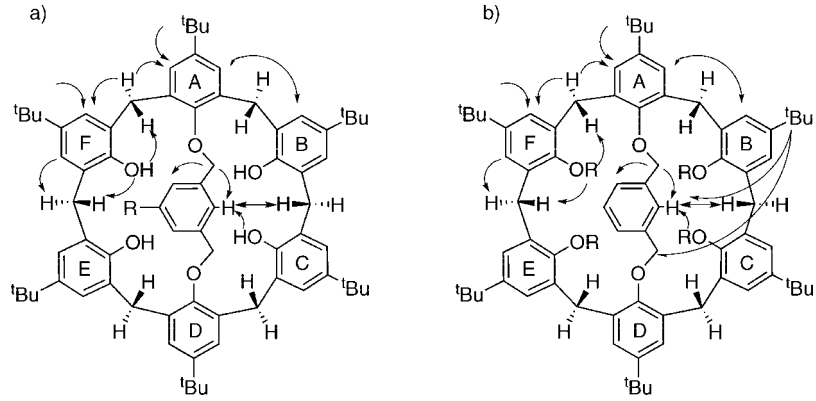

FIGURE 1. ROESY contacts observed for compounds (a) **1**−**4** and (b) **5**−**8**.

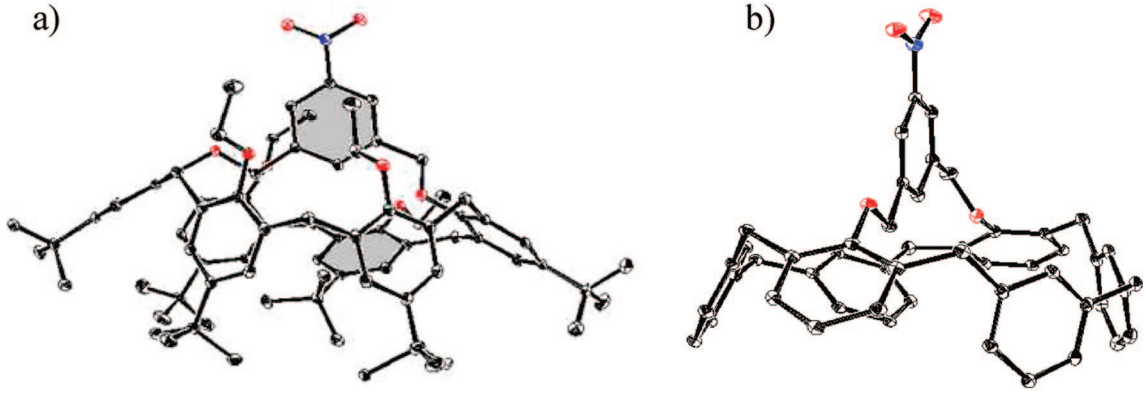

FIGURE 2. X-ray structure of compound **6**: (a) general view and (b) partial view along the *m*-xylylene bridge in which *tert*-butyl and ethoxy groups have been removed for clarity.

the aromatic rings (B, C, E and F) toward the cavity, thus affecting aromatic proton H-2.

The latter hypothesis was confirmed by ROESY experiments. Contacts were observed between the *tert*-butyl groups (B, C, E, and F) and some of the protons at the central bridge (i.e., H-2 of spacer and benzyl CH_2 protons), indicating that at least one of these groups is sequentially folded inside the cavity, whereas analogous contacts are not displayed by the more rigid compounds **1**−**4**, with free OH (Figure 1). In addition, these experiments indicate that all of the aromatic rings are in a *syn* disposition.

Crystals of **6** suitable for X-ray analysis were grown by slow evaporation of a tetrachloroethane/dichloromethane solution. The overall structure of the molecule has an elliptical-cage conformation where the calix[6]arene backbone shows a highly distorted *cone* shape. Five aromatic rings of the calixarene framework are pointing outward with respect to the reference plane defined by the calixarene methylene carbons. The sixth aromatic ring is oriented toward the cavity, showing a CH-π interaction with the aromatic proton H-2 (2.807 Å) of the spacer and 2.505 Å away from the *tert*-butyl group of this aromatic ring, in good agreement with the NMR data (Table 1). On the other hand, each one of the methylene groups of the linker are oriented in opposite directions. Therefore, the X-ray structure of **6** demonstrates that the *cone* conformation is also maintained in the solid state, in good agreement with the conclusions obtained in solution where the aromatic rings are folded into the cavity (Figure 2).

1D and 2D NMR spectra of **9** showed that the calix[4]arene core was in a *pinched cone* conformation (δ ArCH_2Ar 31.6 ppm).[17] In addition, these spectra remained invariable even if the temperature is raised to 403 K. ROESY experiments confirm this conformation. Thus, contacts were observed between the axial proton of the methylene group (ArCH_2Ar) with OH and one of the propyl methylene protons, whereas the equatorial proton showed contacts with the aromatic protons of the calix[4]arene core.

Molecular mechanics were employed to evaluate the overall shape of the structures. An almost perfect agreement between the calculated and the X-ray structures of compound **6** was found when using InsightII/Discovery (cvff, in vacuo, see Supporting Information), so the same method was used for compounds **9** and **10**. Calculations afforded at least three energy minima for compound **9**, all displaying open structures without a defined cavity, whereas **10** presents a more compact shape at the top, similar to dendrimers of a higher generation number (Figure 3).

Conclusions

The synthesis of functionalized A,D-*m*-xylylene-bridged calix[6]arenes in position 5 of the spacer has been described. It was found that all compounds adopt a *cone* conformation. These macrocycles show a new mode of functionalization which paves the way to more complex, branched structures, such as **9** and **10**. Although in this case the branches have been connected to the core by a flexible spacer (CH_2N) and it is not possible to control the inside space of the final resulting structure, we have described a new methodology that can be useful to prepare dendrimeric structures based on rigid calixarenes, by functionalization of the calix[6]arene moieties in *para* positions. The

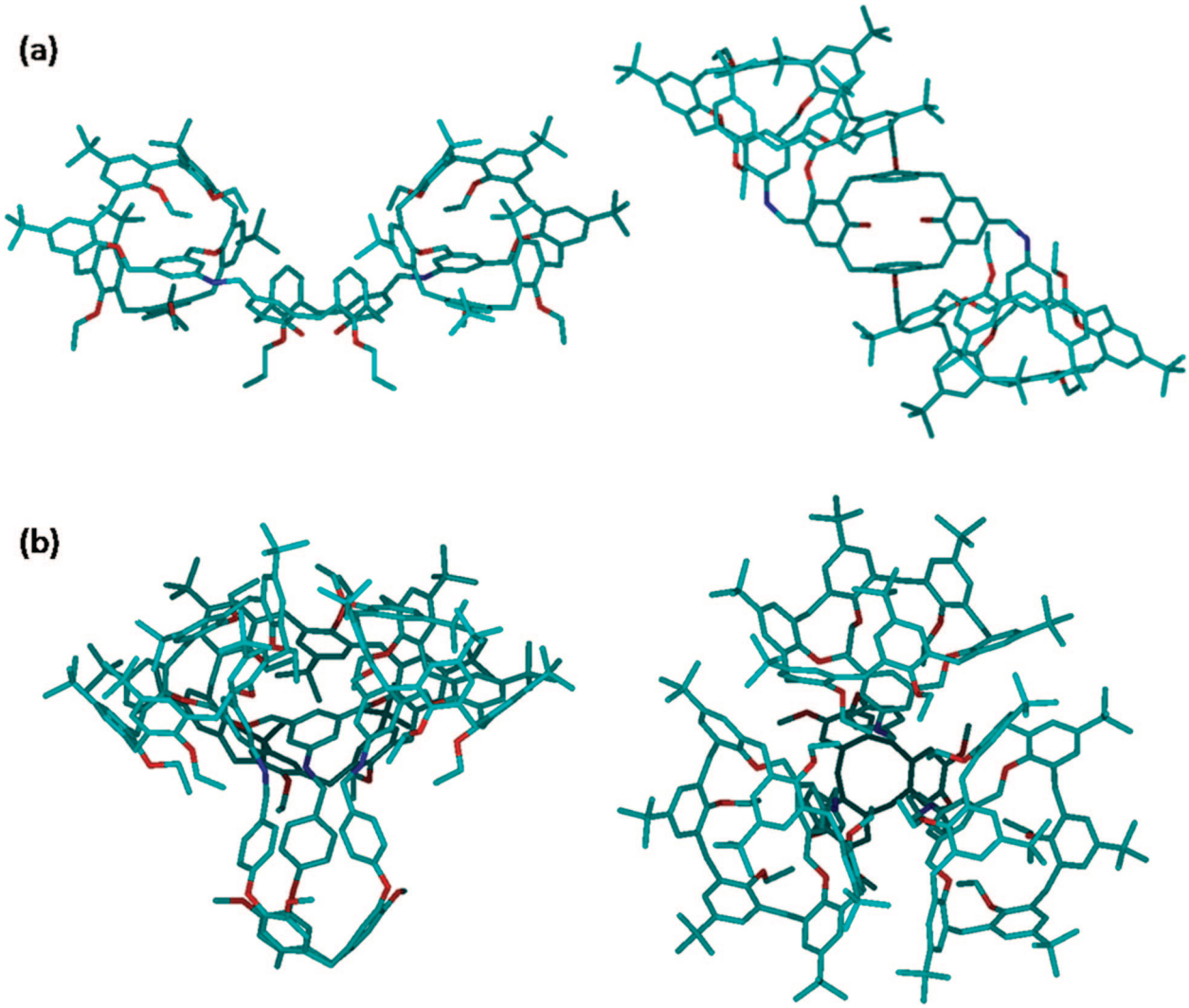

FIGURE 3. Side and top views of the energy optimized structures of amines **9** (a) and **10** (b). Only one conformer is shown for **9**. Hydrogen atoms have been removed for clarity. See Supporting Information for details.

results of our efforts in this direction will be reported independently.

Experimental Section

General Procedure for O-Alkylation of *p-tert*-Butylcalix[6]arene (11) with Dialkylating Agents. A suspension of **11**[8] and NaH (60% on a dispersion oil) in dry THF−DMF (9:1) was heated at 50−60 °C under argon, and a solution of the appropriate alkylating agent in THF−DMF (9:1) was added dropwise while the temperature was raised. The reaction mixture was stirred at specific conditions (temperature, time) for each case under study.

5,11,17,23,29,35-Hexa-*tert*-butyl-37,38,40,41-tetrahydroxy-39,42-[5-nitro-1,3-phenylenebis(methyleneoxy)]calix[6]arene (1). Obtained from **11**[8] (500.0 mg, 0.514 mmol), NaH (128.5 mg, 3.213 mmol), THF−DMF (25.0 mL), and **12**[9] (198.5 mg, 0.643 mmol) in THF−DMF (5.0 mL). The temperature was kept at 40−50 °C for 1.5 h and at room temperature for 15 h. The mixture was quenched with MeOH and concentrated in vacuo. The residue was partitioned between $CHCl_3$ and 1 N HCl. The organic layer was washed with brine and water, dried ($MgSO_4$) and evaporated to dryness The residue was purified by trituration in MeOH, and the solid obtained was crystallized in $CHCl_3$−EtOH, to give **1** as a white solid (440.0 mg, 75%). Mp 212−214 °C. ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.21 [s, 18H, $C(CH_3)_3$], 1.28 [s, 36H, $C(CH_3)_3$], 3.35 (d, ^2J = 13.6 Hz, 2H, $ArCH_2Ar$), 3.53 (d, ^2J = 13.5 Hz, 4H, $ArCH_2Ar$), 4.18 (d, ^2J = 13.6 Hz, 2H, $ArCH_2Ar$), 4.25 (d, ^2J = 13.5 Hz, 4H, $ArCH_2Ar$), 5.36 (s, 4H, $ArOCH_2$), 7.12 (s, 8H, ArH), 7.15 (s, 4H, ArH), 8.05 (s, 2H, ArH), 8.79 (s, 4H, ArOH), 8.87 (s, 1H, ArH); ^{13}C NMR ($CDCl_3$, 125 MHz, DEPT) δ 31.3, 31.7 [$C(CH_3)_3$], 32.8, 33.1 ($ArCH_2Ar$), 34.0, 34.4, [$C(CH_3)_3$], 76.0 ($ArCH_2O$), 120.4, 125.4, 126.1, 126.7 (ArH), 127.1, 127.6 (Ar), 129.3 (ArH), 132.1, 140.4, 142.9, 147.7, 148.4, 149.69, 149.73 (Ar); MS (MALDI-TOF, dithranol + NaI) *m/z* 1142.5 [$(M + Na)^+$, 100%]. Anal. Calcd for $C_{74}H_{89}NO_8 \cdot 1/2EtOH$: C, 78.77; H, 8.11; N, 1.22. Found: C, 78.59; H, 8.68; N, 1.35.

5,11,17,23,29,35-Hexa-*tert*-butyl-37,38,40,41-tetrahydroxy-39,42-[5-(4-nitrophenylethynyl)-1,3-phenylenebis(methyleneoxy)]calix[6]-arene (2). Obtained from **11**[8] (70.7 mg, 0.073 mmol), NaH (18.25 mg, 0.455 mmol), THF−DMF (7.1 mL), and **14** (37.0 mg, 0.091 mmol) in THF−DMF (1.8 mL). The temperature was 50 °C overnight. The mixture was quenched with MeOH and an excess of 1 N HCl. The solid was filtered, washed with water, dried, triturated in EtOH−H_2O, and crystallized in $CHCl_3$−MeOH to give **2** as a white solid (62.0 mg, 70%). Mp > 280 °C (dec). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.22 [s, 18H, $C(CH_3)_3$], 1.29 [s, 36H, $C(CH_3)_3$], 3.35 (d, ^2J = 13.8 Hz, 2H, $ArCH_2Ar$), 3.52 (d, ^2J = 13.5 Hz, 4H, $ArCH_2Ar$), 4.19 (d, ^2J = 13.7 Hz, 2H, $ArCH_2Ar$), 4.31 (d, ^2J = 13.4 Hz, 4H, $ArCH_2Ar$), 5.30 (s, 4H, $ArOCH_2$), 7.13 (s, 8H, ArH), 7.15 (s, 4H, ArH), 7.38 (s, 2H, ArH), 7.68 (d, ^3J = 8.9 Hz, 2H, ArH), 8.23 (d, ^3J = 8.9 Hz, 1H, ArH), 8.58 (s, 1H, ArH), 8.94 (s, 4H, ArOH); ^{13}C NMR ($CDCl_3$, 75 MHz, DEPT) δ

31.3, 31.7 [C(*C*H_3)$_3$], 33.0, 33.2, (Ar*C*H_2Ar), 34.0, 34.3 [*C*(CH_3)$_3$], 76.5 (Ar*C*H_2OAr), 88.1, 93.9 (C≡C), 122.1 (Ar), 123.7, 124.7, 125.3, 126.1, 126.5 (ArH), 127.2, 127.6 (Ar), 129.0 (ArH), 130.0, 132.3 (Ar), 132.4 (ArH), 138.9, 142.8, 147.2, 148.2, 149.90, 149.94 (Ar); MS (MALDI-TOF, dithranol + NaI) *m/z* 1242.7 [(M + Na)$^+$, 100%]; HRMS (MALDI) *m/z* (M + Na)$^+$ calcd for $C_{82}H_{93}NO_8Na$ 1242.68396, found 1242.67934.

5,11,17,23,29,35-Hexa-*tert*-butyl-37,38,40,41-tetrahydroxy-39,42-[3,5-pyridinylbis(methyleneoxy)]calix[6]arene (3). Obtained from **11**[8] (56.4 mg, 0.060 mmol), NaH (14.5 mg, 0.362 mmol) in THF−DMF (5.0 mL), and **13**[10] in THF−DMF (2.0 mL). The reaction was maintained at room temperature for 24 h. The mixture was quenched with water and stirred for an additional 30 min, and then $CHCl_3$ was added. The organic layer was washed with water and dried ($MgSO_4$). The solvent was evaporated to dryness, and the remaining solid was triturated in CH_2Cl_2−MeOH−H_2O to give **3** as a white solid (44.0 mg, 70%). Mp > 196 °C (dec). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.12 [s, 18H, C(CH_3)$_3$], 1.20 [s, 36H, C(CH_3)$_3$], 3.26 (d, ^2J = 13.7 Hz, 2H, ArCH_2Ar), 3.44 (d, ^2J = 13.4 Hz, 4H, ArCH_2Ar), 4.08 (d, ^2J = 13.7 Hz, 2H, ArCH_2Ar), 4.19 (d, ^2J = 13.4 Hz, 4H, ArCH_2Ar), 5.25 (s, 1H, ArOCH_2), 7.04 (s, 8H, ArH), 7.06 (s, 4H, ArH), 8.40 (s, 2H, ArH), 8.79 (s, 1H, ArH), 8.83 (s, 4H, ArOH); ^{13}C NMR ($CDCl_3$, 125 MHz, DEPT) δ 30.3, 30.6 [C(*C*H_3)$_3$], 31.9, 32.1 (Ar*C*H_2Ar), 32.9, 33.3 [*C*(CH_3)$_3$], 73.2 (Ar*C*H_2OAr), 124.3, 125.0, 125.5 (ArH), 126.1, 126.5 (Ar), 130.7 (ArH), 131.2, 132.4, 141.8 (Ar), 146.1 (ArH), 147.3, 148.6, 148.7 (Ar); MS (MALDI-TOF, dithranol + NaI) *m/z* 1098.6 [(M + Na)$^+$, 100%], 1076.6 [(M + H)$^+$, 66.7%]. Anal. Calcd for $C_{73}H_{89}NO_6$·1/2$CHCl_3$: C, 77.70; H, 7.94; N, 1.23. Found: C, 77.35; H, 8.27; N, 1.72.

General Procedure for Reduction of Nitro A,D-*m*-Xylylenedioxycalix[6]arene Derivatives. Method A. A suspension of the corresponding nitro derivative (1 equiv), a catalytic amount of Pd(C) 10%, and hydrazine (100 equiv) in 2-propanol (9×10^{-3} M) was heated at 70 °C for 16 h, under argon. The mixture was filtered on Celite, and the solvent was evaporated to dryness. The residue was partitioned between $CHCl_3$ and water, and the aqueous layer was extracted with $CHCl_3$. The organic layers were joined, washed with water, and dried ($MgSO_4$). The solvent was removed under reduced pressure, and the remaining solid was purified by trituration in MeOH. **Method B.** A suspension of the corresponding nitro derivative and $SnCl_2$·$2H_2O$ (25 equiv/NO_2) in 2-propanol (8×10^{-3} M) was heated at 70 °C under argon for 20 h. The mixture was quenched with 10% NaOH until basic pH and filtered on Celite, and the solid was washed with CH_2Cl_2. The organic layer was washed with water and dried ($MgSO_4$). The solvent was removed under reduced pressure, and the residue was purified by trituration in EtOH−H_2O.

39,42-[5-Amino-1,3-phenylenebis(methyleneoxy)]-5,11,17,23,29,35-hexa-*tert*-butyl-37,38,40,41-tetrahydroxycalix[6]arene (4). Obtained following method B of the general procedure from **1** (200.0 mg, 0.178 mmol), $SnCl_2$·$2H_2O$ (1.020 g, 4.461 mmol), and 2-propanol (20 mL). Yield (170.0 mg, 87%). Mp > 224 °C (dec). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 1.19 [s, 18H, C(CH_3)$_3$], 1.27 [s, 36H, C(CH_3)$_3$], 3.31 (d, ^2J = 13.9 Hz, 2H, ArCH_2Ar), 3.47 (d, ^2J = 13.5 Hz, 4H, ArCH_2Ar), 4.18 (d, ^2J = 13.9 Hz, 2H, ArCH_2Ar), 4.32 (d, ^2J = 13.5 Hz, 4H, ArCH_2Ar), 5.17 (s, 4H, ArOCH_2), 6.46 (s, 2H, ArH), 7.10 (s, 8H, ArH), 7.12 (s, 4H, ArH), 7.92 (s, 1H, ArH), 9.03 (s, 4H, ArOH); ^{13}C NMR ($CDCl_3$, 125 MHz, DEPT) δ 31.3, 31.7 [C(*C*H_3)$_3$], 33.0, 33.2 (Ar*C*H_2Ar), 33.9, 34.3 [*C*(CH_3)$_3$], 77.2 (ArOCH_2), 112.5, 114.2, 125.3, 126.0, 126.4 (ArH), 127.4, 127.6, 132.4, 139.3, 142.5, 147.8, 150.0, 150.1 (Ar); MS (MALDI-TOF, dithranol + NaI) *m/z* 1112.7 [(M + Na)$^+$, 100%), 1090.7 [(M + H)$^+$, 50%], 1034.7 [(M + H − *t*-Bu)$^+$, 19%]. Anal. Calcd for $C_{74}H_{91}NO_6$·1/2(H_2O.MeOH): C, 80.21; H, 8.49; N, 1.26. Found: C, 79.92; H, 8.57; N, 1.30.

39,42-[5-Amino-1,3-phenylenebis(methyleneoxy)]-5,11,17,23,29,35-hexa-*tert*-butyl-37,38,40,41-tetraethyloxycalix[6]arene (7). Obtained following method A of the general procedure from **6** (50.0 mg, 0.044 mmol), Pd(C) 10% (5 mg), hydrazine (0.21 mL, 4.413 mmol), and 2-propanol (5 mL). Yield (36.0 mg, 74%). Compound **7** was also obtained following method B of the general procedure from **6** (296.0 mg, 0.240 mmol), $SnCl_2$·$2H_2O$ (1.80 g, 6.007 mmol), and 2-propanol (30 mL). Yield (226.0 mg, 78%). Mp 185 °C. ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.91 [s, 36H, C(CH_3)$_3$], 1.14 (t, ^3J = 7.1 Hz, 12H, CH_3), 1.44 [s, 18H, C(CH_3)$_3$], 3.25 (d, ^2J = 13.9 Hz, 2H, ArCH_2Ar), 3.44 (d, ^2J = 15.4 Hz, 4H, ArCH_2Ar), 3.66−3.56 (m, 8H, OCH_2), 4.13 (s, 4H, ArOCH_2), 4.36 (d, ^2J = 14.1 Hz, 2H, ArCH_2Ar), 4.45 (d, ^2J = 15.4 Hz, 4H, ArCH_2Ar), 4.76 (s, 1H, ArH), 6.53 (s, 2H, ArH), 6.81 (s, 4H, ArH), 6.89 (s, 4H, ArH), 7.34 (s, 4H, ArH); ^{13}C NMR ($CDCl_3$, 125 MHz, DEPT) δ 15.6 (ArOCH_2CH_3), 29.7, 30.2 (Ar*C*H_2Ar), 31.3, 31.7 [C(*C*H_3)$_3$], 34.0, 34.3 [*C*(CH_3)$_3$], 68.8 (ArOCH_2CH_3), 71.7 (ArOCH_2), 109.6, 113.3, 124.1, 125.1, 128.1 (ArH), 132.8, 132.9, 133.4, 139.3, 145.0, 152.3, 152.7 (Ar); MS (MALDI-TOF, dithranol + NaI) *m/z* 1224.8 [(M + Na)$^+$, 95%], 1202.8 [(M + H)$^+$, 100%], 1146.7 [(M + 2H − *t*-Bu]$^+$, 35%]. Anal. Calcd for $C_{82}H_{107}NO_6$·1/2$CHCl_3$: C, 78.49; H, 8.58; N, 1.11. Found: C, 78.65; H, 8.87; N, 1.22.

General Procedure for Tetra-O-alkylation of A,D-*m*-xylylenedioxycalix[6]arenes with Monoalkylating Agents. Method A. A suspension of the corresponding A,D-*m*-xylylenedioxycalix[6]-arene derivative and NaH (60% on a dispersion oil, 4 equiv/OH) in dry DMF was heated under argon at 60 °C for 30 min, and then ethyl iodide (2 equiv/OH) was added. The reaction was stirred at 50−60 °C for 3 days. The mixture was quenched with an excess of MeOH and concentrated under reduced pressure. The residue was partitioned between $CHCl_3$ and 1 N HCl, and the organic layer was washed with brine and water and dried ($MgSO_4$). The solvent was removed under reduced pressure, and the residue was triturated in MeOH and then crystallized in $CHCl_3$−MeOH. **Method B.** A mixture of A,D-*m*-xylylenedioxycalix[6]arene derivative and NaH (60% on a dispersion oil, 4 equiv/OH) in dry DMF was heated in a sealed tube for 30 min at 50 °C, under argon. The reaction was allowed to reach room temperature, then ethyl iodide was added (2 equiv/OH), and the mixture was heated for 2 days at 80 °C. The mixture was quenched with MeOH and worked up similarly as for method A.

5,11,17,23,29,35-Hexa-*tert*-butyl-37,38,40,41-tetraethyloxy-39,42-[5-nitro-1,3-phenylenebis(methyleneoxy)]calix[6]arene (6). This compound was obtained following method A of the general procedure by reaction of **1** (400.0 mg, 0.353 mmol), NaH (225.9 mg, 5.650 mmol), DMF (20 mL) with ethyl iodide (0.226 mL, 2.824 mmol). Yield (195.0 mg, 45%). In addition, **6** was also prepared following method B of the general procedure by reaction of **1** (200.0 mg, 0.178 mmol), NaH (114.2 mg, 2.850 mmol), DMF (10 mL) with ethyl iodide (0.114 mL, 1.412 mmol). Yield (149.5 mg, 68%). Mp > 274 °C (dec). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.92 [s, 36 H, C(CH_3)$_3$], 1.07 (t, ^3J = 6.8 Hz, 12H, ArOCH_2CH_3), 1.46 [s, 18H, C(CH_3)$_3$], 3.24 (d, ^2J = 14.0 Hz, 2H, ArCH_2Ar), 3.45 (d, ^2J = 15.3 Hz, 4H, ArCH_2Ar), 3.69−3.58 (m, 8H, ArOCH_2CH_3), 4.23 (s, 4H, ArOCH_2Ar), 4.31 (d, ^2J = 14.0 Hz, 2H, ArCH_2Ar), 4.47 (d, ^2J = 15.3 Hz, 4H, ArCH_2Ar), 5.66 (s, 1 H, ArH), 6.85 (s, 4H, ArH), 6.89 (s, 4H, ArH), 7.38 (s, 4H, ArH), 8.16 (s, 2H, ArH); ^{13}C NMR ($CDCl_3$, 125 MHz, DEPT) δ 15.4 (ArOCH_2CH_3), 28.7, 30.2 (Ar*C*H_2Ar), 31.3, 31.7 [C(*C*H_3)$_3$], 34.0, 34.4 [*C*(CH_3)$_3$], 68.7 (ArOCH_2CH_3), 70.7 (ArOCH_2Ar), 118.3, 124.2, 125.0, 128.0, 129.0 (ArH), 132.7, 132.8, 133.4, 140.6, 145.2, 146.4, 147.5, 152.2 (Ar); MS (MALDI-TOF, dithranol + NaI) *m/z* 1254.8 (MNa$^+$, 100%). Anal. Calcd for $C_{82}H_{105}NO_8$: C, 79.90; H, 8.59; N, 1.14. Found: C 79,68; H 8,87; N 1,25.

5,11,17,23,29,35-Hexa-*tert*-butyl-37,38,40,41-tetraethyloxy-39,42-[5-bromo-1,3-phenylenebis(methyleneoxy)]calix[6]arene (8). This compound was obtained following method A of the general procedure by reaction of **18**[4e] (450.0 mg, 0.389 mmol), NaH (250.0 mg, 6.237 mmol), DMF (40 mL) with ethyl iodide (0.25 mL, 3.112 mmol). Yield (390.0 mg, 80%). Mp > 160 °C (dec). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.91 [s, 36H, C(CH_3)$_3$], 1.14 (t, ^3J = 6.9 Hz, 12H, ArOCH_2CH_3), 1.45 [s, 18H, C(CH_3)$_3$], 3.25 (d, ^2J = 14.1

Hz, 2H, $ArCH_2Ar$), 3.44 (d, ^2J = 15.4 Hz, 4H, $ArCH_2Ar$), 3.71−3.63 (m, 8H, $ArOCH_2CH_3$), 4.16 (s, 4H, $ArOCH_2Ar$), 4.34 (d, ^2J = 14.3 Hz, 2H, $ArCH_2Ar$), 4.44 (d, ^2J = 15.4 Hz, 4H, $ArCH_2Ar$), 5.27 (s, 1H, ArH), 6.82 (s, 4H, ArH), 6.89 (s, 4H, ArH), 7.35 (s, 6H, ArH); ^{13}C NMR ($CDCl_3$, 125 MHz, DEPT) δ 15.5 ($ArOCH_2CH_3$), 29.7, 30.2 ($ArCH_2Ar$), 31.3, 31.7 [$C(CH_3)_3$], 34.0, 34.3 [$C(CH_3)_3$], 68.8 ($ArOCH_2CH_3$), 70.9 ($ArOCH_2CH_3$), 120.8 (Ar), 121.1, 124.1, 125.0, 125.7, 128.0 (ArH), 132.7, 132.8, 133.4, 140.7, 145.1, 146.1, 152.2, 152.4 (Ar); MS (MALDI-TOF, dithranol + NaI) *m/z* 1289.8 [$(M + Na)^+$, 100%] 1210.9 [$(M + Na - Br)^+$, 15%]. Anal. Calcd for $C_{82}H_{105}BrO_6 \cdot H_2O$: C, 76.67; H, 8.40. Found: C, 76.32; H, 8.21.

5,11,17,23,29,35-Hexa-*tert*-butyl-37,38;40,41-bis[naphthalene-2,3-diylbis(methyleneoxy)]-39,42-[5-nitro-1,3-phenylenebis(methyleneoxy)]calix[6]arene (5). A mixture of **1** (100.0 mg, 0.081 mmol) and NaH 60% (127.3 mg, 3.181 mmol, 2 equiv/OH) in dry DMF (18 mL) was heated at 40 °C for 10 min under argon. Then a solution of 2,3-bis(bromomethyl)naphthalene[12] (56.0 mg, 0.178 mmol, 2.2 equiv) in DMF (2 mL) was slowly added. The reaction was heated for 3 h at 40 °C. The mixture was quenched with water and 1 N HCl, stirred for another 30 min and extracted with $CHCl_3$. The organic layer was washed sequentially with 1 N HCl (5 × 15 mL), brine, and water and dried ($MgSO_4$). The solvent was eliminated under reduced pressure, and the residue was triturated in MeOH. The obtained solid was purified by column chromatography (silica gel, hexane−$CHCl_3$, 8:2) to give **5** as a white solid (23.5 mg, 30%). Mp > 269 °C (dec). ^{1}H NMR ($CDCl_3$, 500 MHz) δ 0.95 [s, 36H, $C(CH_3)_3$], 1.47 [s, 18H, $C(CH_3)_3$], 3.01 (d, ^2J = 14.0 Hz, 2H, $ArCH_2Ar$), 3.65 (d, ^2J = 15.1 Hz, 4H, $ArCH_2Ar$), 4.22 (d, ^2J = 13.9 Hz, 2H, $ArCH_2Ar$), 4.41 (s, 4H, $ArOCH_2Ar$), 4.52 (d, ^2J = 15.0 Hz, 4H, $ArCH_2Ar$), 4.79 (d, ^3J = 11.4 Hz, 4H, $ArOCH_2Ar$), 5.05 (d, ^3J = 11.4 Hz, 4H, $ArOCH_2Ar$), 6.54 (s, 1H, ArH), 6.90 (s, 8H, ArH), 7.41−7.45 (m, 8H, ArH), 7.59 (s, 4H, ArH), 7.63−7.73 (m, 4H, ArH), 7.81 (s, 2H, ArH); ^{13}C NMR ($CDCl_3$, 125 MHz, DEPT) δ 30.5, 32.2, ($ArCH_2Ar$), 31.2, 31.7 [$C(CH_3)_3$], 34.0, 34.5 [$C(CH_3)_3$], 70.5, 75.0 ($ArOCH_2Ar$), 117.2, 124.7, 125.6, 126.6, 127.4, 127.8, 129.6 (ArH), 132.7, 133.2, 133.6, 133.8, 134.2, 141.2, 146.0, 147.0, 151.9, 152.2 (Ar); MS (MALDI-TOF, dithranol + NaI) *m/z* 1446.8 [$(M + Na)^+$, 100%]. Anal. Calcd for $C_{98}H_{105}NO_8 \cdot CHCl_3$: C, 77.00; H, 6.92; N, 0.91. Found: C, 76.90; H, 7.14; N, 1.16.

Dimethyl 5-(4-nitrophenylethynyl)isophthalate (16). A suspension of dimethyl 5-iodo-isophthalate (500.0 mg, 1.562 mmol), $Pd(PPh_3)_2Cl_2$ (27.4 mg, 0.025 equiv) and CuI (7.5 mg, 0.025 equiv) in dry DIPEA (15 mL) was stirred at room temperature for 30 min. Compound **15**[18] (276.0 mg, 1.874 mmol) was then added, and the mixture was stirred at 50−70 °C for 18 h. The reaction mixture was diluted with water, the solution was extracted with ethyl acetate, and the organic layer was dried ($MgSO_4$) and filtered on Celite. The solvent was removed under reduced pressure, and the residue was purified by column chromatography (silica gel, hexane−AcOEt 9.5:0.5) to give **16** as a yellow solid (403.6 mg, 76%). Mp 134−137 °C. ^{1}H NMR ($CDCl_3$, 300 MHz) δ 3.98 (s, 6 H, $ArOCH_3$), 7.70 (d, ^3J = 8.7 Hz, 2H, ArH), 8.25 (d, ^3J = 8.9 Hz, 2H, ArH), 8.40 (d, ^4J = 1.5 Hz, 2H, ArH), 8.68 (t, ^4J = 1.5 Hz, 1H, ArH); ^{13}C NMR ($CDCl_3$, 75 MHz, DEPT) δ 52.6 ($ArOCH_3$), 89.1, 92.2 (C≡C), 123.1 (Ar), 123.7 (ArH), 129.3 (Ar), 130.9 (ArH), 131.2 (Ar), 132.5, 136.7 (ArH), 147.4 (Ar), 165.3 (CO); MS (EI) *m/z* 339.1 (M^+, 100%), 308.1 [$(M - OCH_3)^+$, 70%]. Anal. Calcd for $C_{18}H_{13}NO_6$: C, 63.72; H, 3.86; N, 4.13. Found: C, 63.27; H, 3.98; N, 4.20.

1,3-Bis(hydroxymethyl)-5-(4-nitrophenylethynyl)benzene (17). DIBAL-H (3.6 mL, 3.625 mmol, 1 M in CH_2Cl_2) was added dropwise under argon at −13 °C to a solution of **16** (300.0 mg, 0.884 mmol) in dry CH_2Cl_2 (30 mL), and the mixture was stirred for 3 h in the same conditions. CH_2Cl_2 (30 mL) was added, and the reaction was quenched at room temperature with brine and neutralized with 3 M HCl until pH = 7, and the mixture was further stirred at room temperature for 1 h. The organic solvent was eliminated under reduced pressure, and the aqueous solution was extracted with Et_2O. The organic layer was washed with brine and dried ($MgSO_4$). The solvent was removed under reduced pressure and the residue was purified by trituration in hexane−CH_2Cl_2 to give **17** as a pale yellow solid (203.5 mg, 81%). Mp > 192 °C (dec). ^{1}H NMR (CD_3OD, 300 MHz) δ 4.66 (s, 4H, $ArCH_2OH$), 7.44 (s, 1H, ArH), 7.50 (s, 2H, ArH), 7.77 (d, ^3J = 8.9 Hz, 2H, ArH), 8.29 (d, ^3J = 9.0 Hz, 2H, ArH); ^{13}C NMR (CD_3OD, 75 MHz, DEPT) δ 64.5 ($ArCH_2OH$), 88.1, 95.3 (C≡C), 123.5 (Ar), 124.8, 127.4, 129.9 (ArH), 131.3 (Ar), 133.5 (ArH), 143.8, 148.5 (Ar); MS (EI) *m/z* 283.0 (M^+, 100%), 252.0 [$(M - CH_2OH)^+$, 15%]. Anal. Calcd for $C_{16}H_{13}NO_4 \cdot (H_2O \cdot CH_2Cl_2)$: C, 52.87; H, 4.44; N 3.63. Found: C, 52.90; H, 4.04; N, 3.89.

1,3-Bis(bromomethyl)-5-(4-nitrophenylethynyl)benzene (14). A mixture of **17** (50.0 mg, 0.176 mmol), CBr_4 (269.2 mg, 0.812 mmol), and triphenyl phosphine (212.9 mg, 0.812 mmol) in dry CH_2Cl_2 (10 mL) was heated at 40 °C for 1 day. The solvent was removed under reduced pressure, and the residue was triturated in diethyl ether. The filtrate was eliminated under reduced pressure, and the residue was purified by column chromatography (silica gel, hexane−$CHCl_3$, 2:1) to give **14** as a white solid (87.0 mg, 69%). Mp 115−118 °C. ^{1}H NMR ($CDCl_3$, 300 MHz) δ 4.59 (s, 4H, $ArCH_2OH$), 7.44 (s, 1H, ArH), 7.55 (s, 2H, ArH), 7.67 (d, ^3J = 9.0 Hz, 2H), 8.23 (d, ^3J = 8.8 Hz, 4H); ^{13}C NMR ($CDCl_3$, 75 MHz, DEPT) δ 45.1 ($ArOCH_2Br$), 88.4, 93.3 (C≡C), 123.3 (Ar), 123.7, 129.4 (ArH), 129.7 (Ar) 131.7, 132.4 (ArH), 138.6, 147.2 (Ar); MS (EI) *m/z* 411.0 [$(M + 4)^+$, 24%), 409.0 [$(M + 2)^+$, 45%], 407.0 (M^+, 24%), 330.1 [$(M - Br)^+$, 100%], 249.1 [$(M - 2Br)^+$, 50%]; HRMS (EI) *m/z* M^+ calcd for $C_{16}H_{11}Br_2NO_2$ 406.9157, found 406.9165.

5,11,17,23,29,35-Hexa-*tert*-butyl-37,38,40,41-tetraethyloxy-39,42-[5-benzylideneamine-1,3-phenylenebis(methyleneoxy)]calix[6]arene (21). A solution of amine **7** (25.0 mg, 0.021 mmol) and benzaldehyde (2.0 μL, 0.021 mmol) in dry CH_2Cl_2 (3 mL) was stirred at 50 °C for 1 h. Solvent was eliminated under reduced pressure to give **21** as a white solid (26.3 mg, 98%). Mp > 197 °C (dec). ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.98 [s, 36H, $C(CH_3)_3$], 1.15 (t, ^3J = 6.9 Hz, 12H, $ArOCH_2CH_3$), 1.50 [s, 18 H, $C(CH_3)_3$], 3.31 (d, ^2J = 14.2 Hz, 2H, $ArCH_2Ar$), 3.51 (d, ^2J = 15.5 Hz, 4H, $ArCH_2Ar$), 3.64−3.71 (m, 8H, $ArOCH_2CH_3$), 4.31 (s, 4H, $ArOCH_2Ar$), 4.41 (d, ^2J = 14.2 Hz, 2H, $ArCH_2Ar$), 4.54 (d, ^2J = 15.4 Hz, 4H, $ArCH_2Ar$), 5.31 (s, 1H, ArH), 6.89 (s, 4H, ArH), 6.96 (s, 4H, ArH), 7.20 (s, 2H, ArH), 7.42 (s, 4H, ArH), 7.52−7.54 (m, 2H, ArH), 7.67−8.00 (m, 2H, ArH), 8.16 (d, ^3J = 7.4 Hz, 1H, ArH), 8.63 (s, 1H, CH═N); ^{13}C NMR (125 MHz, $CDCl_3$, DEPT) δ 15.6 ($ArOCH_2CH_3$), 28.8, 30.2, ($ArCH_2Ar$), 31.3, 31.7 [$C(CH_3)_3$], 34.3, 34.0 [$C(CH_3)_3$], 68.8 ($ArOCH_2CH_3$), 71.5 ($ArOCH_2Ar$), 115.3, 120.4, 124.1, 125.1, 128.1, 128.7 (ArH), 129.0, 129.8 (Ar), 130.2, 131.0 (ArH), 132.8, 132.9, 133.5, 136.7, 139.5, 145.0, 146.0, 150.4, 152.3, 152.6 (Ar), 158.9 (CH═N); MS (MALDI-TOF, dithranol + NaI) *m/z* 1312.4 [$(M + Na)^+$, 100%], 1290.4 [$(M + H)^+$, 33%]. Anal. Calcd for $C_{89}H_{111}NO_6 \cdot 1/2(CH_2Cl_2 \cdot H_2O)$: C, 80.08; H, 8.49; N, 1.04. Found: C, 80.00; H, 8.80; N, 1.12.

General Procedure To Obtain Secondary Amines by Reductive Amination. Glacial acetic acid (1 equiv/CHO) was added at room temperature under argon to a suspension of amine **7** (2.5 equiv/CHO), the corresponding aldehyde (1 equiv), and $NaBH(AcO)_3$ (1.5 equiv/CHO) in 1,2-dicloroethane, keeping [aldehyde]/n = 22 mM, where n is the number of imine groups to be reduced. The mixture was heated at 60−70 °C for a specified time and then 1 M NaOH was added until a basic pH was reached. The mixture was extracted with CH_2Cl_2, and the organic layer was washed with water and dried ($MgSO_4$). The solvent was eliminated under reduced pressure, and the residue was triturated in CH_2Cl_2−MeOH.

Compound 9. Prepared from **7** (200.0 mg, 0.166 mmol), dialdehyde **22**[13a] (18.8 mg, 0.033 mmol), 1,2-dichloroethane (3 mL),

(18) Takahashi, S.; Kuroyama, Y.; Sonogashira, K.; Hagihara, N. *Synthesis* **1980**, 627–630.

acetic acid (3.8 μL), and $NaBH(AcO)_3$ (21.0 mg, 0.100 mmol) for 6 days at 70 °C. Purification was achieved by repeated crystallization in CH_2Cl_2−MeOH giving **9** as a white solid (68.0 mg, 70%). Mp > 229 °C (dec). ^{1}H NMR (500 MHz, $CDCl_3$, COSY) δ 0.93 [s, 72H, $C(CH_3)_3$], 1.11 (t, ^3J = 6.9 Hz, 3H, $ArOCH_2CH_2CH_3$), 1.16 (t, ^3J = 6.8 Hz, 24H, $ArOCH_2CH_3$), 1.34 (t, ^3J = 7.3 Hz, 3H, $ArOCH_2CH_2CH_3$), 1.46 [s, 36H, $C(CH_3)_3$], 2.07−2.14 (m, 4H, $ArOCH_2CH_2CH_3$), 3.28 (d, ^2J = 14.2 Hz, 4H, $ArCH_2Ar_{calix[6]arene}$), 3.39 (d, ^2J = 12.9 Hz, 4H, $ArCH_2Ar_{calix[4]arene}$), 3.46 (d, ^2J = 15.5 Hz, 8H, $ArCH_2Ar_{calix[6]arene}$), 3.58−3.71 (m, 16H, $ArOCH_2CH_3$), 4.00 (t, ^3J = 6.1 Hz, 4H, $ArOCH_2CH_2CH_3$), 4.15 (s, 4H, $ArCH_2NHAr$), 4.16 (s, 8H, $ArOCH_2Ar$), 4.35 (d, ^2J = 12.3 Hz, 4H, $ArCH_2Ar_{calix[4]arene}$), 4.39 (d, ^2J = 14.1 Hz, 4H, $ArCH_2Ar_{calix[6]arene}$), 4.48 (d, ^2J = 15.5 Hz, 8H, $ArCH_2Ar_{calix[6]arene}$), 4.75 (s, 2H, ArH), 6.50 (s, 4H, ArH), 6.79 (t, ^3J = 7.6 Hz, 2H, $ArH_{calix[4]arene}$), 6.83 (s, 8H, $ArH_{calix[6]arene}$), 6.91 (s, 8H, $ArH_{calix[6]arene}$), 6.98 (d, ^3J = 7.6 Hz, 4H, $ArH_{calix[4]arene}$), 7.08 (s, 4H, $ArH_{calix[4]arene}$), 7.36 (s, 8H, $ArH_{calix[6]arene}$), 8.36 (s, 2H, OH); ^{13}C NMR (125 MHz, $CDCl_3$, DEPT, HMQC) δ 10.9, 15.7 (CH_3), 23.5 ($ArOCH_2CH_2CH_3$), 28.8, 30.2 ($ArCH_2Ar_{calix[6]arene}$), 31.3 [$C(CH_3)_3$], 31.5 ($ArCH_2Ar_{calix[4]arene}$), 31.7 [$C(CH_3)_3$], 34.0, 34.3 [$C(CH_3)_3$], 48.7 ($ArCH_2NHAr$), 68.8 ($ArOCH_2CH_3$), 71.9 ($ArOCH_2Ar$), 78.4 ($ArOCH_2CH_2CH_3$), 107.4, 112.2, 124.1, 125.0, 125.4, 127.8, 128.1 (ArH), 128.2 (Ar), 129.0 (ArH), 130.3, 132.8, 132.9, 133.4, 133.6, 139.1, 144.9, 145.7, 147.6, 152.0, 152.3, 152.5, 152.8 (Ar); MS (MALDI-TOF, dithranol + NaI) *m*/*z* 2960.9 [(M + Na)$^+$, 100%]. Anal. Calcd for $C_{200}H_{250}N_2O_{16}\cdot 1/2CH_2Cl_2$: C, 80.79; H, 8.49; N, 0.94. Found: C, 80.90; H, 8.66; N, 0.99.

Compound 10. Prepared from **7** (100.0 mg, 0.083 mmol), trialdehyde **24**[15] (13.3 mg, 0.018 mmol), 1,2-dichloroethane (2.5 mL), acetic acid (3.2 μL), and $NaBH(AcO)_3$ (17.6 mg, 0.083 mmol) for 11 days at 70 °C. Purification was achieved by gel permeation chromatography using Bio-Beads SX-1 as stationary phase and toluene as eluent, followed by repeated crystallization in CH_2Cl_2−MeOH gave **10** as a white solid (9.2 mg, 12%). Mp > 170 °C (dec). ^{1}H NMR (500 MHz, $CDCl_3$) δ 0.91 [s, 108H, $C(CH_3)_3$], 1.07 (t, ^3J = 6.9 Hz, 36H, $ArOCH_2CH_3$), 1.44 [s, 54H, $C(CH_3)_3$], 3.25 (d, ^2J = 14.2 Hz, 6H, $ArCH_2Ar_{calix[6]arene}$), 3.41−3.44 (m, 16H, $ArCH_2Ar_{calix[6]arene}$, $ArCH_2Ar_{CTV}$), 3.46−3.58 (m, 33H, $ArOCH_2CH_3$, $ArOCH_3$), 3.70 (s, 6H, $ArCH_2NH$), 4.14 (s, 12H, $ArOCH_2Ar$), 4.34−4.46 (m, 21H, $ArCH_2Ar_{calix[6]arene}$, $ArCH_2Ar_{CTV}$), 4.66 (s, 3H, ArH), 6.58 (s, 6H, ArH), 6.72 (s, 3H, ArH_{CTV}), 6.81 (s, 12H, $ArH_{calix[6]arene}$), 6.89 (bs, 18H, ArH, $ArH_{calix[6]arene}$), 6.93 (s, 3H, ArH_{CTV}), 7.19 (d, ^3J = 8.4 Hz, 6H, ArH), 7.34 (s, 12H, $ArH_{calix[6]arene}$); ^{13}C NMR (125 MHz, $CDCl_3$, DEPT) δ 15.9 (CH_3), 29.1, 30.4 ($ArCH_2Ar_{calix[6]arene}$), 31.5, 32.0 [$C(CH_3)_3$], 34.0, 34.3 [$C(CH_3)_3$], 36.6 ($ArCH_2Ar_{CTV}$), 53.9 ($ArCH_2NHAr$), 56.4 ($ArOCH_3$), 69.0 ($ArOCH_2CH_3$), 72.3 ($ArOCH_2Ar$), 107.4, 111.7, 114.5, 117.6, 124.4, 125.4, 128.4, 128.5 (ArH), 133.1, 133.2, 133.7, 133.8, 139.5, 145.2, 146.0, 148.2, 152.6, 153.1 (Ar); MS (MALDI-TOF, dithranol + NaI) *m*/*z* 4364.1 [(M + Na + HAcO)$^+$, 100%]; HRMS (MALDI) *m*/*z* (M + Na + HAcO)$^+$ calcd for $C_{293}H_{361}N_3O_{26}Na$ 4360.6909, found 4360.7085.

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Supporting Information Available: Spectral characterization data (**1**−**10**, **14**, **16**, **17**, and **21**); ROESY spectra of compounds **1**−**9**; VT ^{1}H NMR spectra (403−298 K) of compounds **1**, **3**, **4**, **6**, **8**, and **9**; X-ray crystallographic data of compounds **6**; HRMS of compound **10**. This material is available free of charge via the Internet at http://pubs.acs.org.

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