to flow rapidly.

As conclusion we showed that the underpotentially deposited lead acts as a catalyst for the oxygen reduction at a gold substrate in nitric acid and perchloric acid. The catalytic reduction current of oxygen during the lead UPD could be estimated by elimination of lead UPD current using our low noise EQCM.

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Synthesis of Alkyl-Substituted Bispidinones and 3-Aza-1,3,5-trimethylbicyclo[3,3,1]nonan-9-one

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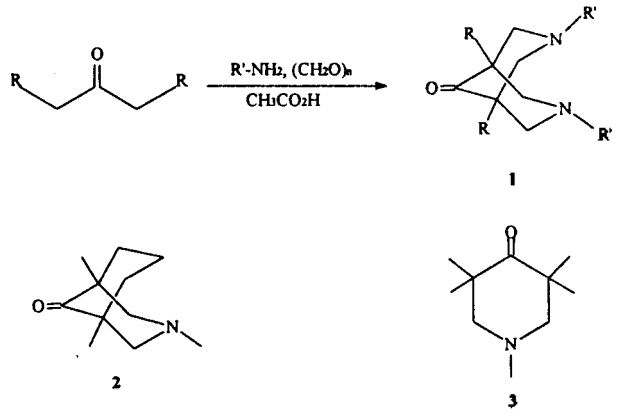
During the last 20 years, some of perfluorochemicals (perfluorodecalin, perfluorotripropylamine etc.) have drawn much attention on their potential biomedical applications.[1] These chemicals, so-called blood substitutes, appear to be useful for perfusing isolated organs and other clinical applications due to their biological inertness and high capacities for dissolving gases.[2] However, the absence of versatile synthetic method for perfluorination has put restriction upon the development of new perfluorochemicals. One of the authors (RJL) has been interested for decades in the synthesis of new class of perfluoro-organic compounds by the LaMar direct fluorination[3] with F_2. And a cyclic perfluoro(polyketone)[4] was recently synthesized for the first time by the liquid-phase direct fluorination methodology.[5] Thus, we decided to use bispidinone derivatives[6] as the precursor on which liquid-phase direct fluorination would be applied for the development of improved blood substitute.

In this paper, we would like to report the synthesis of various alkyl-substituted bispidinones **1** and 3-aza-1,3,5-trimethylbicyclo[3,3,1]nonan-9-one(**2**) by the Mannich reaction.[7]

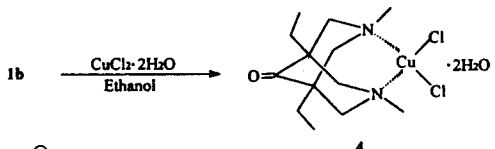


To the solution of a primaryamine (480 mmol), acetic acid (30 mL, 520 mmol) in ethanol (200 mL) at 0 ℃ was added paraformaldehyde (30 g, 1.00 mol) and a ketone (220 mmol), the resulting suspention was heated at reflux for 5 hrs and *ca.* 100 mL of ethanol was distilled off. The reaction mixture was cooled and diluted with ether (500 mL). The solution was acidified with perchloric acid (70%) and the mixture was kept in a refrigerator overnight. The perchlorate salt was collected and partitioned between dichloromethane and an aqueous sodium hydroxide solution (20%). The organic extracts were dried (Na_2SO_4) and concentrated. Re-extraction with hexane and evaporation of solvents gave the crude product. Further purification with vacuum distillation or flash chromatography provided the bispidinone **1** or **2**.

As shown in Table 1, the yields of bispidinones **1** are acceptable considering the fact that good yields could be obtained only from the irreversible product formation by crystallization or precipitation.[6a] Also, 3-aza-1,3,5-trimethylbicyclo [3,3,1]nonan-9-one (**2**) is successfully synthesized from 2,6-dimethylcyclohexanone in 15% yield. The existence of Bohlmann bands[6b] (2843, 2774, 2727 cm^{-1}) in the IR spectrum of **2**, the unusual chemical shift (δ 3.017) of one hydrogen

Table 1. The Yields of Bispidinones **1**

1	R	R'	Yield[a]
a	CH_3	n-C_3H_7	18
b	C_2H_5	CH_3	44
c	C_2H_5	n-C_3H_7	28
d	n-C_3H_7	CH_3	35



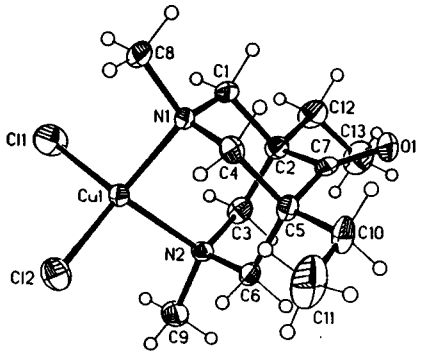


Figure 1. The crystal structure of **4**.

on C-7 and the multiplicities in the ^{1}H NMR spectrum of **2** are good indications of the chair-chair conformation and the proximity between the axial hydrogen on C-7 and the nitrogen in the compound **2**. On the other hand, an attempt to produce 1,3,3,5,5-pentamethyl-4-oxo-piperidine (**3**)[9] from 2,4-dimethyl-3-petanone by the same reaction condition ended up in vain. The failure of synthesis of **3** demonstrates that for the formation of a ring the Mannich reaction can be more effective with a cyclic ketone reactant than acyclic one. This fact might be attributed to an entropy effect in a ring formation.

From **1b** and $CuCl_2 \cdot 2H_2O$, the copper complex **4** is synthesized as green needles in 78% yield. Figure 1 clearly shows that the bispidinone **1b** adopts the chair-chair conformation in the complex **4**.[10] The liquid-phase perfluorination of **1** and **2** is now underway and the result will be published in due course.

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8. The yields are for isolated, pure products. The ^{1}H NMR and ^{13}C NMR spectra were taken on a Varian QE-300 with $CDCl_3$ as an internal standard. High resolution mass spectra were obtained with a VG analytical ZAB2-E and infrared analysis was taken with a Biorad FTS-40 fourier transform infrared spectrophotometer. The melting point is not corrected.
1a: ^{1}H NMR δ 0.841 (t, J=7.5 Hz, 6H), 0.945 (s, 6H), 1.395 (tq, J=7.2 Hz, 7.5 Hz, 4H), 2.222 (t, J=7.2 Hz, 4H), 2.291 (d, J=10.6 Hz, 4H), 2.921 (d, J=10.6 Hz, 4H); ^{13}C NMR δ 11.83, 20.31, 20.39, 46.35, 58.67, 65.82, 215.93; IR 1724 cm^{-1}; HRMS (CI) for $C_{15}H_{28}N_2O$ found 252.21978, calcd. 252.22016. **1b**: ^{1}H NMR δ 0.781 (t, J=7.5 Hz, 6H), 1.406 (q, J=7.5 Hz, 4H), 2.212 (s, 6H), 2.292 (d, J=10.5 Hz, 4H), 2.890 (d, J=10.5 Hz, 4H); ^{13}C NMR δ 7.41, 25.95, 45.32, 48.98, 65.70, 215.69; IR 1720 cm^{-1}; HRMS (CI) for $C_{13}H_{24}N_2O$ found 224.18836, calcd. 224.18886. **1c**: ^{1}H NMR δ 0.801 (t, J=7.5 Hz, 6H), 0.842 (t, J=7.5 Hz, 6H), 1.40 (m, 8H), 2.253 (t, J=7.4 Hz, 4H), 2.347 (d, J=10.8 Hz, 4H), 2.860 (d, J=10.8 Hz, 4H); ^{13}C NMR δ 7.48, 11.85, 20.32, 26.21, 49.31, 58.92, 63.35, 216.03; IR 1721 cm^{-1}; HRMS (CI) for $C_{17}H_{32}N_2O$ found 280.25035, calcd. 280.25146. **1d**: ^{1}H NMR δ 0.855 (t, J=7.2 Hz, 6H), 1.30 (m, 8H), 2.212 (s, 6H), 2.306 (d, J=10.8 Hz, 4H), 2.909 (d, J=10.8 Hz, 4H); ^{13}C NMR δ 14.92, 16.31, 35.85, 45.36, 49.02, 66.15, 215.41; IR 1718 cm^{-1}; HRMS (CI) for $C_{15}H_{28}N_2O$ found 252.21900, calcd. 252.22016. **2**: ^{1}H NMR δ 0.821 (s, 6H), 1.313 (td, J=6.4Hz, 12.8 Hz, 1H), 1.611 (ddd, J=6.4 Hz, 12.8 Hz, 13.2 Hz, 2H), 1.971 (dd, J=6.0 Hz, 13.2 Hz, 2H), 2.075 (s, 3H), 2.098 (d, J=12.0 Hz, 2H), 2.862 (d, J=12.0 Hz, 2H), 3.017 (ttd, J=6.0 Hz, 12.8 Hz, 12.8 Hz, 1H); ^{13}C NMR δ 20.81, 21.05, 42.82, 44.90, 46.87, 69.50, 218.66; IR 2969, 2925, 2843, 2774, 2727, 1718 cm^{-1}; HRMS (CI, M$^+$+1) for $C_{11}H_{20}NO$ found 182.15450, calcd. 182.15449. **4**: mp 147-148 °C (ethanol); IR (KBr) 3590-3330 (w), 1728, 1251, 1064 cm^{-1}; HRMS (CI, M$^+$+1) for $C_{13}H_{29}N_2O_3Cl_2Cu$ found 394.08777, calcd. 394.08512.
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10. We thank Dr. Thomas Kottke for the X-ray analysis of **4**. Experimental condition, bond lengths and angles are available from the authors on masthead page.