Results on the structure determination and molecular aspects of a series of RuCl₄ cluster complexes are presented. Details on their potential significance as homogeneous catalysts, as well as their electronic structure in some cases, are also given. The study includes, among others, the following trinuclear compounds: [Ru₂(μ-H)₂(μ-η²-SC₆H₅NH₂)Cl₂][ClO₄] (I), [Ru₂(μ-H)₂(μ-η²-SC₆H₅NH₂)Cl₂][IO₄] (II), [Ru₂(μ-ampy)(μ-η²-SC₆H₅NH₂)Cl₂][BF₄]·CsH₁₂ (III), and [Ru₂(μ-Ph)(μ-η²-SC₆H₅NH₂)Cl₂][BF₄]·CsH₁₂ (IV). Complete structural analysis was carried out, and the results are presented in detail. The electronic structure of the clusters was investigated, and the electronic spectra were compared with the experimental data. The magnetic properties of the clusters were also studied, and the results are presented in detail. The structure of the clusters was determined by X-ray diffraction, and the results are presented in detail. The electronic structure of the clusters was investigated, and the results are presented in detail. The magnetic properties of the clusters were also studied, and the results are presented in detail. The structure of the clusters was determined by X-ray diffraction, and the results are presented in detail.

Three different polymorphs of [Au(dppm)Cl]²⁺ have been successfully grown from dichloromethane (DCM). The only different growth condition is that the DCM solution of the title compound contains different amount of water. Polymorph I and II were obtained from dried DCM solution. Two other polymorphs, which were co-crystallized with either acetone or acetonitrile were reported. The molecular structures of these four polymorphs were similar except that they have different co-crystallized solvents. Short Au-Au contact and terminal type of Au-Cl bond have been observed in these polymorphs. They are 2.975(3) Å for polymorph I and 3.007(1) Å for polymorph II, which are comparable to those found in the other two polymorphs. Though all of these polymorphs show similar terminal Au-Cl bond, polymorph II has exceptional short Au-Au distance of 2.760(3) Å. Polymorph III was crystallized from DCM solution saturated with water. The molecular structure in this polymorph is totally different from the others. One of the bridging between two Au(I) centers and the other is served as a counter ion. Two Au-Cl distances are 2.977(9) and 2.955(9) Å. This is the first and the only polymorph of [Au(dppm)Cl]²⁺ with bridging Cl⁻. The Au-Au separation, 2.938(3) Å, is significantly shorter than those found in the terminal type of Au polymorphs. Due to the structural difference, the luminescent maximum for polymorph III is different from the others.

Crystal Data: polymorph I, a=13.047(1), b=19.425(2), c=11.531(1) Å, β=116.120(1)°, V=2623.8(6) Å³, monoclinic, Pccn (I), R=0.0438, T=200 K. Polymorph II, a=23.712(2), b=19.931(2) Å, c=116.120(1)°, V=4352-4359 Å³, monoclinic, Pccn (I), R=0.0549, T=200 K. Polymorph III, a=23.712(2), b=19.931(2) Å, c=116.120(1)°, V=4352-4359 Å³, monoclinic, Pccn (I), R=0.0549. Very nice crystals were indeed formed with the surprising incorporation of nitrobenzene molecules in the crystal. X-ray data for these crystals have been collected at room temperature, 200 K and 9 K. However, some effect causing reversible splitting of diffraction intensities is at work below 200 K resulting in the 200 K structure being the best determined at this point.