

Environmentally Friendly Rhodium(I) Model Catalysts tailored by various bidentate and monodentate (water soluble) ligand

Z. G. Morerwa, Andreas Roodt and Alice Brink

Department of Chemistry, University of the Free State, Bloemfontein, 9301, South Africa

z.morerwa@gmail.com

Green chemistry aspires to meet sustainable development, while manufacturers are able to meet the needs of current economic development, without compromising the ability of future generations. It provides challenges to those who practice chemistry in industry, education and even research. Based on the benefits that it has in human health, environment and even the economy, it has become vital in changing the tarnished image of chemical research.

Aqueous organometallic chemistry receives much attention due to their many advantages in aqueous medium presented to stoichiometric and catalytic reactions.^{1, 2} Long term exposure of chemical pollution and waste which are absorbed through epidermal contact or inhalation can lead to deleterious effects on the respiratory, haematological, and thyroid functioning.³ Hence the importance of replacing toxic solvents with greener alternatives is an important concept. The importance in a model water-soluble homogeneous rhodium (I) catalyst, with various N,O; O,O'; and N,N' bidentate ligand, is to understand the *relationship* between activity and the catalyst structure.^{4,5,6,7}

This project focuses on the investigation of N,O; O,O' and N,N' bidentate 5 and 6 membered ring systems, in conjunction with water soluble tertiary phosphine ligands, in rhodium complexes and their potential application in catalysis. The goal is to synthesise a potentially effective water-soluble rhodium catalyst that is easier to separate from the product, has high selectivity and activity, and is environmentally friendly. The aim is to focus on carbonylation, homologation and hydroformylation reactions, as well as water splitting reactions (to generate molecular hydrogen as energy source), in order to explore and to justify the proof of the concept.

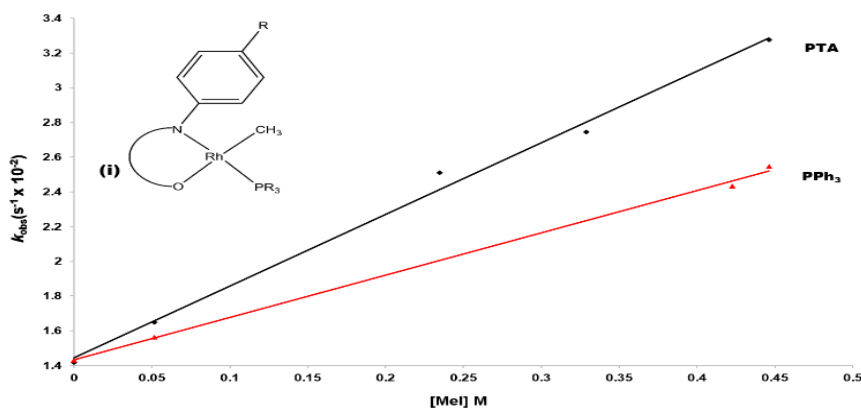


Figure 1: Plot of the observed rate constant vs. iodomethane concentration for the iodomethane oxidative addition to complexes [Rh(4-CH₃-Phony)(CO)(PTA)] and [Rh(4-CH₃-Phony)(CO)(PPh₃)] in dichloromethane at 25 °C; [Rh] = 3.36 × 10⁻⁴ M and [MeI] = 0.052 - 0.44 M. Insert (i) depicts [Rh(4-CH₃-Phony)(CO)(PR₃)] with R representing various electron withdrawing and donating groups.

[1] F. Joo', *Aqueous Organometallic Catalysis*, Kluwer: Dordrecht, 2001.

[2] B. Cornils, W.A. Herrmann, *Aqueous-Phase Organometallic Catalysis. Concepts and Applications*, 1998, Wiley-VCH: Weinheim.

[3] N. Uzma, B.M.K.M. Salar, B.S. Kumar, N. Aziz, M.A. David, V.D. Reddy, *Int. J. Environ. Res. Public Health*, 2008, **3**, 5.

[4] S.S. Basson, J.G. Leipoldt, A. Roodt, J.A. Venter, T.J. Van Der Walt, *Inorg. Chim. Acta*, 1986, **119**, 35.

[5] A. Roodt, G.J.J. Steyn, *Recent Res. Devel. Inorgani. Chem*, 2000, **2**, 1.

[6] G.J.S. Venter, G. Steyl, A. Roodt, *Acta. Cryst.*, 2011, **67**, 11.

[7] Z.G. Morerwa, G.J.S. Venter, *South African Journal of Science and Technology*, 2019, **38**, 1.

Keywords: Green chemistry; Model catalyst; Rhodium(I) complex; Water-soluble.