

Reviews

Nickel and palladium *N*-heterocyclic carbene complexes. Synthesis and application in cross-coupling reactions*

Z. N. Gafurov,^{a,b} A. O. Kantyukov,^b A. A. Kagilev,^b A. A. Balabayev,^b O. G. Sinyashin,^a and D. G. Yakhvarov^{a,b*}

^a*A. E. Arbuzov Institute of Organic and Physical Chemistry,
Kazan Scientific Center of the Russian Academy of Sciences,
8 ul. Arbuzova, 420088 Kazan, Russian Federation.
Fax: +7 (843) 273 2253. E-mail: yakhvar@iopc.ru*

^b*Kazan Federal University,
18 ul. Kremlyovskaya, 420008 Kazan, Russian Federation*

N-Heterocyclic carbenes (NHCs) are widely used as ligands in catalysis by transition metal complexes. The catalytic activity of transition metal NHC complexes is much higher than that of the transition metal complexes bearing the phosphine and nitrogen-containing ligands. They show excellent catalytic performance in different transformations of the organic compounds, especially in the carbon–carbon and carbon–element bond forming reactions. Palladium NHC complexes are very efficient catalysts for the cross-coupling reactions. On the other hand, nickel is less expensive and regarded as a promising alternative to palladium and, therefore, it attracts increasing attention from the researchers. The present review is focused on the recent advances in the synthesis of *N*-heterocyclic carbene complexes of nickel and palladium and their application in catalysis of cross-coupling reactions of organic, organoelement and organometallic compounds with organic halides.

Key words: *N*-heterocyclic carbenes, nickel and palladium complexes, homogeneous catalysis, cross-coupling reactions.

Introduction

N-Heterocyclic carbenes (NHCs) closely resemble electron-rich phosphines (PR₃). These carbenes show low toxicity and pronounced σ donating properties easily tun-

able by varying the substituents at the nitrogen atom, and known to exert electronic and steric effects. Due to these unique properties, NHCs are versatile and indispensable class of ligands applied in coordination chemistry and homogeneous catalysis by transition metal complexes. Transition metal NHC complexes gain increasing importance in materials sciences, medicine, and, especially, catalysis.^{1–3} The most extensively studied reactions

* Dedicated to Academician of the Russian Academy of Sciences G. A. Abakumov on the occasion of his 80th birthday.