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Review

The chemistry of the carbon–transition metal double and triple bond: Annual survey covering the year 2006☆

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Contents

Abstract

This is a review of papers published in the year 2006 that focus on the synthesis, reactivity, or properties of compounds containing a carbon–transition metal double or triple bond.

Keywords: Carbene complexes; Alkylidene complexes; Carbyne complexes; Metallacumulenes; Olefin metathesis; Alkyne metathesis

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☆ For 2005, see J.W. Herndon, Coord. Chem. Rev. 251 (2007) 1158.

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1. Introduction

This survey is intended to be a comprehensive summary of articles that report on the synthesis, reactivity, or properties of compounds featuring a multiple bond between carbon and a transition metal. Reactions that employ metal–carbene complexes as transient intermediates generated through well-established routes are not covered, unless there is some effort to characterize the carbene complex intermediate. Several reviews in this area appeared in 2006 [1–4]. Although a determined effort has been made to include patents, in general only patents that focus on the metal–carbene or metal–carbyne complex are included. Patents that appear in 2006 editions of *Chemical Abstracts* have been included. Only compounds which feature a multiple bond between a single carbon atom and a single transition metal are discussed in this survey, thus bridging carbene and carbyne complexes are not covered unless there is a multiple bond to at least one transition metal. The complexes of *N*-heterocyclic (or Arduengo) carbenes with transition metals have not been included; since the π-donation component of these complexes is usually minimal, there is no formal carbon–metal multiple bond [5–8]. This area was reviewed several times in 2006 [9–16] and the back donation issue was evaluated experimentally [17,18] and computationally [19], and found to be present to some extent. This survey has been divided into two sections, metal–carbene (or alkylidene) complexes and metal–carbyne (or alkylidyne) complexes; the carbene complex section represents the vast majority of this article. The metal–carbene section has been organized according to metal, starting from the left side of the Periodic Table. The Ionic Model [20] has been employed for the discussion of oxidation states and ligand electron count throughout this survey. A special section focusing on alkene metathesis has been included prior to the discussion of carbene complexes of individual metals. The metal–carbyne section has been organized according to reaction type. Articles from the journals *Angewandte Chemie International Edition*, *Chemistry: A European Journal*, *Tetrahedron*, and *Tetrahedron Letters* are restricted to volumes 45, 12, 62, and 47, respectively, which covers the period of December 2005–December 2006 according to some search engines.

Abbreviations (see also the front of issue #1 of the *Journal of Organic Chemistry* [21]).

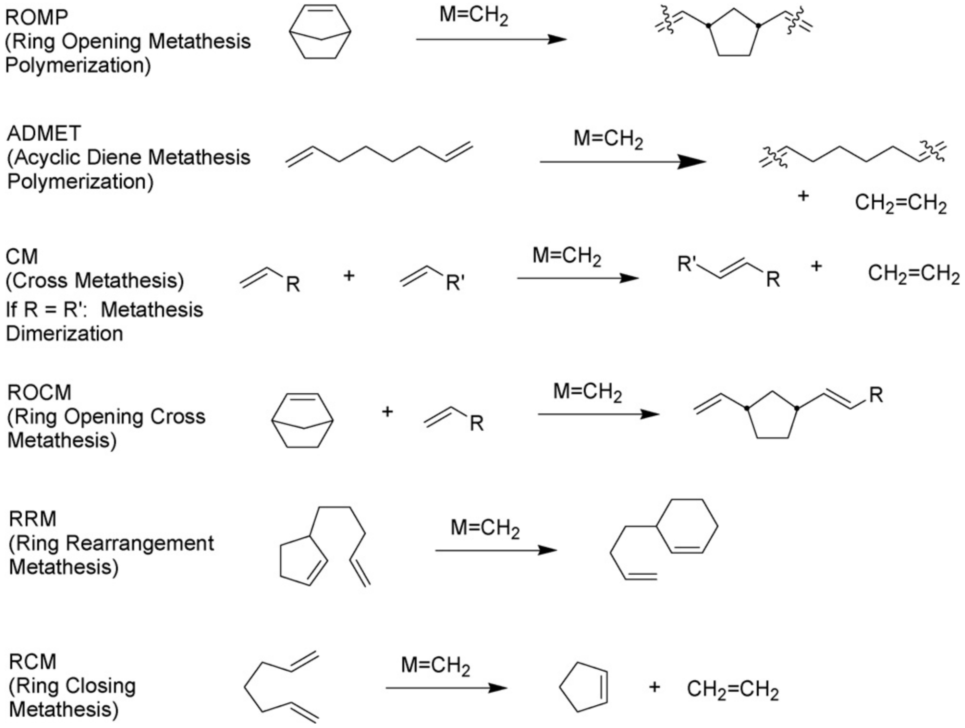
DFT	Density functional theory
NHC	*N*-heterocyclic carbene
Grubbs catalyst I	Structure **1** (Fig. 1)
Grubbs catalyst II	Structure **2** (Fig. 1)
Grubbs catalyst III	Structure **3** (Fig. 1)
Hoveyda–Grubbs catalyst	Structure **4** (Fig. 1)
Schrock catalyst	Structure **5** (Fig. 1)

See also Scheme 1for abbreviations of distinct modes of metathesis.

2. Metal–carbene or metal–alkylidene complexes

2.1. Review articles and comments

Several reviews/comments covering aspects of metal–carbene complex chemistry appeared in 2006. Many articles focusing on some aspect of carbene complex-initiated olefin metathesis were published, including the following specific subjects: (1) the early days of olefin metathesis [22]; (2) the



Scheme 1.