Silver Carbonate

Compiled by Igor Dias Jurberg

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Introduction

Silver carbonate, Ag₂CO₃, is a odorless, yellow to yellow-grey powder poorly soluble in water. Upon heating, it gradually decomposes to silver oxide, Ag₂O, and CO₂ close to its melting point of 210 °C. Silver carbonate is commercially available, but can also be readily accessed through the reaction of cheaper silver nitrate with sodium carbonate in water (Scheme 1).¹

Scheme 1 Silver carbonate is easily obtained from silver nitrate and sodium carbonate

Silver carbonate can also be used to prepare other silver salts. One such salt, particularly useful in catalysis is silver bis(trifluoromethanesulfonyl)imide, derived from the reaction of silver carbonate and triflimide (Scheme 2).²

Scheme 2 Silver carbonate can also be used for the preparation of other useful silver salts

Silver carbonate has found a myriad of different uses in organic chemistry, notably as oxidizing agent (Fetizon’s reagent), as catalyst for alkyne activation, as halogen scavenger and as base and/or oxidant of choice for various transition-metal-catalyzed reactions. Selected applications of silver carbonate in these diverse contexts will be presented here.

Abstracts

(A) Oxidation of Alcohols:
Fetizon’s reagent (silver carbonate on celite) is known to be a mild oxidizing agent capable of converting alcohols into aldehydes and ketones.³ Here, this reagent is applied in the complex setting of an enantioselective total synthesis of (+)-upial.⁴ The desired lactone was obtained from the corresponding lactol in excellent 94% yield.

(B) 5-Exo-dig Cyclization of Alcohols and Carboxylic Acids:
Alcohols containing a proximal acetylenic part⁵ and isoidolones containing γ-acetylenic carboxylic acid moieties⁶ can be efficiently cyclized using a catalytic amount of Ag₂CO₃.
(C) **Halogen Scavenger: Generation of Nitrilimines:**
The azetof[3',4'-2,3']pyrazole skeleton holds potential interest as a β-lactamase-resistant antibiotic. An enantioselective route towards one member of this class was developed from the intramolecular [3+2] cycloaddition of a nitrilimine and a proximal alkene. The nitrilimine was generated via chlorine abstraction from the parent hydrazinonyl chloride using silver carbonate.  

(D) **Halogen Scavenger: C–H Oxidation Strategy:**
In landmark work, a C–H oxidation strategy was employed for the synthesis of eudesmane terpenes. The syntheses of two of them, dihydroxyeudesmane and pygmol, feature as key steps the selective alkylation of benzoic acid derivatives by means of a tramolecular arylation of benzoic acid derivatives using silver carbonate.  

(E) **Halogen Scavenger: Aziridinium Ion Formation:**
A chiral anion phase-transfer catalysis was established by taking advantage from the low solubility of silver carbonate and the generally high solubility of (S)-TRIP salts in organic solvents. Silver carbonate abstracts the chlorine atom to generate an aziridinium phosphate ion complex, whose chiral anion directs the enantioselective nucleophilic attack. After hydrolysis of the cyclic carbonate formed, the corresponding diol is obtained in a very selective manner.  

(F) **Base/Oxidant for Decarboxylative Cross-Coupling:**
An efficient, regio- and chemoselective palladium-catalyzed intramolecular arylation of benzoic acid derivatives by means of a decarboxylation/C–H activation sequence using silver carbonate as base and oxidant of choice has been described.  

(G) **Oxidant for Olefination–Michael Addition Sequence:**
The use of dinuclear rhodium species [Cp*RhCl2]2 as catalyst and Ag2CO3 as oxidant allows direct access to Heck cross-coupled products. After hydrolysis of the cyclic carbonate formed, the corresponding amino ethers in good yields and excellent enantioselectivities.  

References

5. Other examples using stoichiometric amounts of Ag2CO3 have also been reported: Pale, P.; Chuhe, J. *Eur. J. Org. Chem.* 2000, 1019.  
9. This can be seen as a particular case of a more general concept coined as asymmetric counteranion-directed catalysis. For a leading reference, see: Mayer, S.; List, B. *Angew. Chem. Int. Ed.* 2006, 45, 4193.  