



## Cross-dehydrogenative coupling of aldehydes with *N*-hydroxyimides: An efficient and straightforward route to *N*-hydroxyimides esters

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### ABSTRACT

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Esterification of *N*-hydroxyimides to corresponding active esters (*N*-hydroxyimide esters) is one of the most important organic transformations not only for their importance as versatile intermediates for amides and esters but also their use as coupling partners in various C-S, C-C and C-N coupling reactions. Therefore, there is continuing interest in the development of efficient, practical, and straightforward methodologies for their construction. Nowadays, cross-dehydrogenative coupling reactions, which combine two unmodified C(X)-H (X = heteroatom) bonds for the fabrication of new C(X)-C(X) bonds, are recognized as a fundamental synthetic tool for highly atom-economical synthesis of a wide variety of organic compounds. Along this line, recently, several procedures have been reported for the synthesis of *N*-hydroxyimide esters through the oxidative C-O coupling of with aldehydes with *N*-hydroxyimides. This review highlights recent progresses in this interesting research field.

### 1. Introduction

*N*-Hydroxyimide esters are one the most specific class of active esters and extremely promising building blocks in organic synthesis due to their diverse reaction patterns.

These compounds are widely used as versatile raw materials in various carbon-carbon and carbon-heteroatom bond forming reactions. For example (Figure 1), they were successfully applied in the synthesis of sulfides [1], boronate esters [2], hydrazones [3], aryloxyamines [4] and many more [5-10].

Traditionally, the titled compounds were synthesized by the direct coupling of carboxylic acids with *N*-hydroxyimides in the presence of *N,N'*-dicyclohexylcarbodiimide [11].

However, poor atom efficiency and difficult purification have limited the range of applications this approach. Thus, new and efficient methodologies for *N*-hydroxyimide esters are very desirable.

Cross-dehydrogenative-coupling reactions, which combine two C(X)-H (X= heteroatom) bonds to form new C-C and C-X bonds, are valuable and powerful tools in modern organic synthesis that can avoid the use of pre-functionalized starting materials and thus make synthetic schemes shorter, simpler and cleaner [12].

Recently, several groups have reported the synthesis of *N*-hydroxyamide esters from aldehydes and *N*-hydroxyimides *via* oxidative cross-dehydrogenative coupling, either in the presence of a metal catalyst or under metal-free conditions.

In connection with our series of review papers on cross-coupling reactions [13-19] and green chemistry [20-25], we summarize here a variety of methods for the synthesis of *N*-hydroxyamide esters from aldehydes and *N*-hydroxyimides (Figure 2), with special emphasis on the mechanistic features of the reactions.

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