



Società Chimica Italiana

SCI2021

**XXVII CONGRESSO NAZIONALE DELLA
SOCIETÀ CHIMICA ITALIANA**

**LA CHIMICA GUIDA LO
SVILUPPO SOSTENIBILE**

14-23 SETTEMBRE 2021

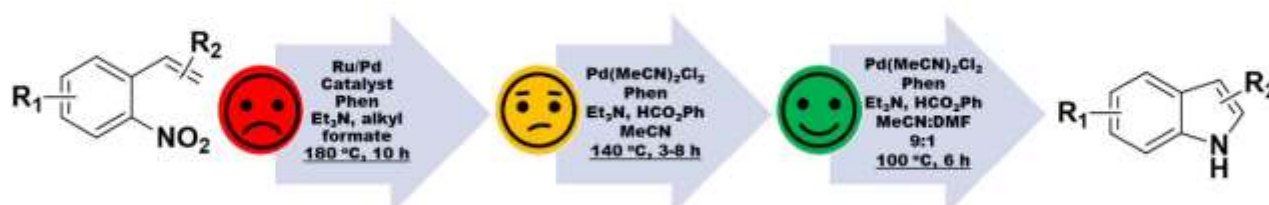
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From *o*-nitrostyrenes to indoles: metal catalyzed reductive cyclization of *o*-nitrostyrenes using formate esters as CO surrogates

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Over thirty years ago, Cenini and co-workers reported the first reductive cyclization reaction of *o*-nitrostyrenes to indoles utilizing carbon monoxide as the reductant, employing different transition metals as catalysts under forcing conditions (220 °C, 80 bar CO).^[1] Despite the high efficiency and the high atom-economical character of these reactions, they have not become of widespread use. This is mainly due to the need to use pressurized CO, requiring safety measures that are not accessible in most synthetic organic laboratories. Our group introduced alkyl and aryl formates as efficient, powerful, low-toxic, and cheap *in-situ* CO-releasers, that avoid to employ pressurized CO and autoclaves, in the metal-catalyzed reductive cyclization reactions of *o*-nitrostyrenes to indoles. A cheap glass pressure tube can be used as the reaction vessel which transforms this kind of reaction into a “General Tool” to the synthetic chemist. Owing to the minimal cost of alkyl formates, the initial investigation was directed to their use as CO releaser. A bimetallic Ru/Pd-catalytic system was required to achieve both the formate decomposition and the *o*-nitrostyrene reductive cyclization with satisfactory yields. However fulfilling results were accomplished uniquely under harsh conditions (180 °C, up to 10 h). On the other hand, when phenyl formate was employed, complete conversions and good selectivities were accomplished at lower temperature (140 °C) and using a Pd/phenanthroline complex as the catalyst.^[2] Nevertheless, the temperature was still moderately high and resulted in a low selectivity in the cyclization of some substrates. Here we report the results of a further optimization that permitted us to improve both selectivity and yield. The milder reaction temperature and a mixed CH₃CN/DMF solvent system allowed to get improved yield for several substrates including some for which previous conditions failed to afford the indole.



[1] C. Crotti, S. Cenini, B. Rindone, S. Tollari, F. Demartin, *J. Chem. Soc. Chem. Commun.* **1986**, 10, 784.

[2] D. Formenti, F. Ferretti, F. Ragaini, *ChemCatChem* **2018**, 10, 148.