The many faces of copper: catalysis of cross-coupling and radical processes

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Organic synthesis clearly is today a central science with deep implications in various domains such as biology, medicine or material sciences. Considering the extent of chemical methodology's contributions to other disciplines, there is a high and growing demand for efficient procedures to assemble or selectively functionalize complex molecules or pharmaceuticals from simple building blocks. This drive for shorter, general and more efficient synthetic procedures, as well as the quest for molecular diversity, has fueled the development of new reactions that efficiently contributed to the selective syntheses of ever larger and more complex systems with increased efficiency.

Organometallic catalysis has played a central role in this area over the last decades. Among all metal that can efficiently catalyze a range of organic reactions, copper has been extremely studied over the last twenty years, for various reasons. These include the low cost of this metal, which is actually one of the cheapest one that can be used in catalysis, the limited toxicity of most copper complexes, and, more importantly, the broad range of transformations that can be efficiently catalyzed with metal complexes. Indeed, the oxidation states that are readily accessible with such complexes enable not only their use in cross-coupling processes but also in oxidative and annelating cross-coupling reactions. They have also been more recently found to be remarkably efficient for the catalysis of radical processes, enabling the generation of radical species under remarkably mild conditions.

Selected examples of such reactions developed in the group will be discussed.