Transition metal catalyst prompts 'conjunctive' cross-coupling reaction

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By employing a third reactant, researchers at Boston College have developed a new type of 'cross coupling' chemical reaction, building on a Nobel Prize-winning technique that is one of the most sophisticated tools available to research chemists, the team reports in the journal *Science*.

Transition metal catalyzed cross-coupling reactions were the subject of the 2010 Nobel Prize in chemistry. A key component of that novel approach—known as Suzuki-Miyaura coupling—connects two types of reactants, including one electron donor and one electron acceptor.

Boston College Professor of Chemistry James P. Morken and his team report using transition metals to develop an alternative cross-coupling process that merges two electron donors while they react with the electron acceptor. The resulting 'conjunctive' reaction takes place efficiently and offers a high degree of selectivity, the team reports.

"Our first significant step was determining that transition metals could facilitate the merger of two organic reactants in a manner commonly observed for other non-metallic chemical reagents," said Morken, the Louise and James Vanderslice and Family Professor of Chemistry at BC. "Once the team made this connection, then we narrowed our focus to consider ways in which catalysis might be achieved."

In a field as widely studied as transition metal cross-coupling, Morken said the researchers were surprised to uncover a new variation on the ground-breaking catalytic method. The team's early research shows that

the new type of reaction can be efficient and selective, two characteristics prized by the researchers who use these types of catalysts, Morken said.

The team's focus is now on finding abundant and cost-effective metal compounds to enable the three-reactant cross-coupling, said Morken, whose research team included graduate students Liang Zhang, Gabriel J. Lovinger, Emma K. Edelstein, Adam A. Szymaniak, and Matteo P. Chierchia.

"Our team is addressing the limitations found in the early stage development and I think in the long-term that this mode of catalysis will have an impact on the way organic compounds are manufactured, most likely those used in the pharmaceutical industry," said Morken. "If the underlying reactivity can be used in other catalytic chemical processes, then that should open up a broad new collection of chemical reactions that will be of use in chemical manufacture."

More information: L. Zhang et al. Catalytic conjunctive cross-coupling enabled by metal-induced metallate rearrangement, *Science* (2015). DOI: 10.1126/science.aad6080

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